The London School of Economics and Political Science

Governing through the Climate

Climate Change, the Anthropocene, and Global Governmentality

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DECLARATION

I certify that the thesis I have presented for examination for the MPhil/PhD degree of the London School of Economics and Political Science (LSE) is solely my own work other than where I have clearly indicated that it is the work of others (in which case the extent of any work carried out jointly by me and any other person is clearly identified in it). I also certify that any work included in this thesis that has been published prior to its completion is clearly indicated with the reference information of publication.

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ABSTRACT

The concept of anthropogenic climate change is now understood in the discipline of International Relations (IR) as an urgent environmental problem enveloping the globe. It underlies recent claims that humanity's impact on the Earth's natural systems is so consequential that a new geologic epoch has begun: The Anthropocene, or the 'human age'. Yet, IR's increasing engagement and use of these scientific concepts raises significant questions the discipline has yet to address. For instance, if global climate change appeared in international politics only as recently as the late-1980s, what spurred this sudden emergence? If the Anthropocene appeared only after 2000, then how does this new concept affect the way we now think about global politics, the Earth, and even ourselves? This thesis answers these questions by arguing that the concepts of global climate change and the Anthropocene are neither immutable nor universal scientific truths or natural objects. Rather, they emerged when technological advances in nuclear physics and models tracing bomb radiocarbon intersected with the ways states govern their territories and subjects. The global nature or 'climatic globality' of these concepts, therefore, is a manner of conducting and steering human conduct and action by establishing the boundaries of subjectivity when they are thought. This is what Michel Foucault called governmentality. It is demonstrated in this thesis through a genealogical tracing of climate change in IR, focusing on how nuclear sciences, computational modelling technologies, and regimes of international governance, overlapped to form the climatic globality IR now takes for granted. Combining genealogy with the philosophies of Martin Heidegger and Hannah Arendt, a new form of global governmentality becomes evident. Through a technological and metaphysical subjectivism with the carbon atom as its substrate, the human self now asserts itself from atomic to global scales, as the maker, master, and steward, of the Earth.

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Chapter 1 – Crises of Global Climate Change and the Anthropocene

Introduction

This thesis explores how the application of scientific processes to a political territory can transform how human beings think, and how they are governed. It does so through an historical and philosophical analysis of two global environmental crises now commonly asserted to be affecting international politics today: anthropogenic climate change, and the rise of a new, human-induced geologic epoch called the Anthropocene.

Through a genealogical methodology, it aims to illustrate how human subjectivity can be shaped and molded – from atomic to global levels – by certain concepts derived from the natural sciences when they are applied to politics. These concepts shape a human subject's boundaries of thought, delimiting certain forms of political action whilst bracketing others. Hence, it argues that global climate change and the Anthropocene are neither innocuous nor objective scientific concepts or truths. Instead, both are conceptual technologies that shape how human beings place themselves spatially and temporally within their historical, social, and political world(s).

As our current crises of climate change and the Anthropocene intensify, their transnational, global, and scientific status is eliciting increased concern and attention in the discipline of International Relations (IR). IR has long been critical of how the social sciences have generally examined these issues in a 'top-down' fashion, lamenting its overindulgence on theories positing international regimes and institutions as rational actors, or game-theorizing the choices of individual decision makers and citizens in establishing their personal preferences (Stripple and Bulkeley 2014; Helm and Hepburn 2009). It is common to read that environmental crises previously discounted as 'low-politics' are now gaining currency, portending a rise into the mainstream scholarship of the discipline in the near future. "Given these trends," Deudney astutely predicted,

(1990, 461), "environmental issues are likely to become an increasingly important dimension of political life at all levels – locally, inside states, as well as internationally."

What each lens omits, however, is the crucial role and impact that human practice, action, agency, power, and subjectivity play in creating and knowing these global crises. Understanding how humans have now come to 'think' of climate change and the Anthropocene as normal or everyday concepts is thus the impetus of this project. For example, these issues are known to us today only through their creation and dissemination through incredibly complex computer models and simulations. Rather, the 'climate' as we know it does not exist until it is made real by quantifying atmospheric flows of carbon at a global scale, requiring a deluge of data to be organised and translated by supercomputers into manners and forms only then suitable for human comprehension and knowledge (Edwards 2011; Oreske 2000). Yet, the science, history, and the effect(s) of these quantified concepts are largely ignored in IR. Self-declaredly critical IR scholarship tends to restrict itself to three approaches, exploring: (a) the imaginary of climate change, or how different cultures or polities might conceive of it as an issue or threat; (b) the role played by advanced or neoliberalism in generating and perpetuating this crisis; and (c) the "conduct of carbon conduct", or the forming of individual selves and subjectivities through the regulating, monitoring, and even securitising of carbon (Stripple and Bulkeley 2014, 10). Yet, these approaches proceed without inquiring into what scientific concepts such as 'carbon' or 'climate' actually are, where they came from, or what it is they do when they are borrowed from the atmospheric sciences and implanted into IR discourses. What these critical accounts take for granted, therefore, are the conceptual and social preconditions for even thinking of a 'global' climate change and an Anthropocene epoch in the first place: the (natural) sciences and technologies delimiting these concepts of Nature in ways that grant the space and potential for some forms of thought and action, whilst bracketing others. Notably, these critical approaches also tend to conflate the human ego, or 'I', with the concept of subject and subjectivity. Seeking to move beyond subject/object binaries, they gravitate towards (new) materialist or posthumanist approaches that eschew or claim to move beyond anthropocentric notions of the 'I' and the subject by adopting a

flat or relational ontology with all matter(ing). However, and as will be argued below, the combination of the 'I' with the subject is not immutable or universal, but it is part and parcel of the same conceptual (and metaphysical) grounds upon which IR's Anthropocene and climate change discourses rest. By problematising this metaphysical foundation, this thesis avoids conflating the I and the subject, raising the possibility that a new understanding of the relationship of the human being to subjectivity, and to politics in the supposed 'Anthropocene' epoch, may therefore be emerging: not the familiar Cartesian self-certainty of subjectivity as the 'I', but rather, a subjectivity reconceptualised as a notion of the *We*. As will be argued below, this 'We' is emerging through a shared world picture of climatic globality that asserts the human species as a new entity stretching across time and space (see Chakrabarty 2009).

As such, this thesis makes a new contribution to IR and the social sciences by problematising how our present concepts of a 'global' climate change and Anthropocene epoch have emerged and become commonplace through sciences and technologies embraced by the modern nation-state. Its first goal is thus to understand how these sciences and technologies have contributed to our thinking of climate change and the Anthropocene the way we commonly do today: as global crises made by, and hence to be resolved by, a human stewardship of all life on Earth.

The second goal of this thesis is to expand upon the analytics of governmentality (Foucault 2007) and global governmentality (Neumann and Sending 2010; Larner and Walters 2006) now commonly used in IR. It does so by interpreting how recent applications of climate science and Earth system science (ESS) to planetary flows of carbon resembles the processes and dynamics captured through the application of statistics to the state in the sixteenth and seventeenth centuries (Foucault 2007, 2008). It thus detects a new style of thought or political rationality (Miller and Rose 2008, 14) emerging from the application of ESS to the globe. This is a form of subjectivity in which the human self relates itself to all forms of life and matter, as its steward or creator, through the shared medium of carbon. The range of this atom becomes a conceptual bridge between the subjectivity of the human 'I', and atomic and global

scales and referents. As later chapters of this thesis illustrate, it even bridges the present moment into futures of deep geologic time, and justifies IR's recent use of quantum science and notions of 'entanglement'. This new political rationality wrought by carbon – the endless thinking of human relations upon (carbonic) relations – is what is identified in this thesis as a new form of global governmentality: a "relationality". How this relationality emerges through the sciences and technologies underpinning climate change and the Anthropocene, is thus one of the contributions this thesis project hopes to make to IR.

In making this argument, this thesis embraces a genealogical methodology. It traces and interprets how we have come to take these familiar concepts – global climate change and the Anthropocene – as everyday or normal in our current discourse. In other words, this genealogy is nominalist at its outset, but upon looking back at the completion of this project, it tells a story. At its beginning in 1945[1] is a localized, objective, and sovereign state climate studied by nuclear physicists tracing radioactive bomb fallout – the radionuclide of carbon C-14 – throughout Earth's atmosphere. The middle of this story is comprised of an organic form of carbon that replaces nuclear carbon as an object of international concern. What emerges is our current prognostication (and in some cases, implicit celebration) of a looming Anthropocene epoch, in which a carbonic *anthropos* – man, or the human[2] – internalises this concept of atomic and global carbon into its own sense of self, and its own being in the world. The end of this story lies in how this emergent understanding of humanity and Nature in the Anthropocene shapes our commonsensical understanding of climate change and globality today. Confronted with an incalculable scale and uncertainty concerning these looming crises, the human subject now establishes certainty by implicitly reflecting these concepts back through itself: *Anthropos* – the human – as the self-certain destiny of Nature, and the maker and the measure of all things. Yet, here, humanity is subtly reconceptualised as a subject stretching across unprecedented spatialities and temporalities, or as a We, instead of an

[1] The details of how this particular start date was selected is explained in chapters 2 and 4.
[2] *Anthropos* is a gendered Greek word for 'man', whilst *gyneka* is the Greek word for 'woman'. The terms 'man' and 'human' will be used interchangably throughout the thesis in reference to *anthropos* depending on the textual sources from which it is derived. Whenever possible, 'human' is preferred and used.

I. This genealogical narrative aims not to declare a single or ironclad truth about climate change or the Anthropocene, therefore, but aims to help us to understand these concepts anew, creating the potential for IR scholars to think act differently when considering these crises of globality in the future.

This project will now be elaborated in the remainder of this introductory chapter by examining its context, problematique, argument, methodology, and method, in greater detail.

The Context: Crises of Climatic Change in the Anthropocene Epoch

In December of 2015, the largest international conference ever recorded took place in Paris, France. It was conducted under the auspices of the 21st session of the Conference of the Parties (COP) to the UN's Framework Convention on Climate Change (UNFCCC). 'COP21', as it was called, aimed to finally establish one shared universal agreement amongst the leaders of states, transnational corporations, international and multinational organizations, and civil society groups alike: to combat the growing threat of anthropogenic climate change to the future of humanity and to all life on the Earth.

Concluding on 12 December, 2015, COP21's 'Paris Agreement' was signed by 195 countries. Its aim: to reduce greenhouse gas emissions so as to limit the global temperature increase of Earth to within 1.5 degrees Celsius of anthropogenic warming. As UN Secretary General Ban Ki-moon declared, this was both the most difficult and the most important agreement ever made. The Paris Agreement "is not a moment of talking about national perspective", he stressed. "Good global solutions will help good local solutions," and hence all nation-states must now "make final decisions for humanity" (UN 2015). In other words, international relations now had planetary implications, deciding the fate of humanity and the Earth alike. The scope of political action was no longer national or inter-national, but global. The future of the Earth was at stake.

Yet, despite COP21's recognition of the calamitous global impact that humanity is wreaking upon the bio- and geo-physical processes of the Earth, it is now extremely likely that the Paris Agreement is a "fantasy" that will fail (Tollerson 2015). In a recent joint statement to international media, some of the world's top climate scientists warn that it was mere political fodder; a smokescreen or flare designed to placate or calm nervous domestic constituents, encouraging them to continue their carbon-based 'business-as-usual' lifestyles whilst hoping that a sociopolitical environmental change was somehow on the horizon. "What people wanted to hear was that an agreement had been reached on climate change that would save the world while leaving lifestyles and aspirations unchanged", these scientists claimed. "The solution it [COP21] proposes is not to agree on an urgent mechanism to ensure immediate cuts in [carbon] emissions, but to kick the can down the road" (Bawden 2016). Indeed, even as the ink on the Paris Agreement was still wet, stunned climate scientists balked at the agreement's impossible targets; the economic and social reluctance of states and their citizens to reduce their consumption of carbon and fossil-fuels; the billions of dollars given to, and still spent, lobbying government representatives and diplomats to support powerful global fossil-fuel corporations; the entrenchment and growing support of industries and infrastructures dependent upon carbonic economic production and transportation; and, most importantly, the flimsiness and weakness of a global agreement that is not legally binding, but voluntary in nature (McKibben 2015).

Why would the UNFCCC push for, and widely celebrate and laud to the world, a Paris Agreement that scientists knew was doomed to fail? Geden (2015) has argued that it served a variety of domestic functions aiding the state: to create legitimacy for UN policymakers and the COP process; to create a moment for leaders and states to claim responsibility for saving the planet; and to mobilize further action around climate negotiations so as to spur future institutional changes that reduce carbon consumption. Other IR scholars highlight how this failure is typical of collective action problems arising from the anarchic nature of the Westphalian system; the selfishness of powerful states such as the US and China; or the increasing material consumption demanded by a growing global middle class now embracing forms of capitalist consumerism (Harris

2013; Depledge and Yamin 2009). “In short, nearly two decades after [the 1997 Kyoto Protocol], states have yet to agree to binding emissions reductions that will prevent dangerous climatic change according to the best contemporary advice of Earth system scientists”, note Burke et al. (2016, 509). “Objects in this mirror are closer than they appear.”

However, what these explanations omit is the wider discursive and background context within which climate negotiations, climate governance, and ultimately international relations, now take place. As van Munster and Sylvest (2016, 2) recently point out, if we do not treat states as bounded ahistorical units acting rationally throughout history, then what becomes visible are transformative and “crucial developments since 1945 – the nuclear revolution, the space race and the rise of global environmentalism – [that] have produced a politics of globality”. Globality typically refers to circumstances in which the human world is considered as a single place. It is not a timeless or universal condition, but “a social fact whose basic structure, genesis, dissemination and subsequent functions can be opened to historical and sociological inquiry” (Bartelson 2010, 231). This raises the question of how exactly climate change, and events such as COP21, are ways of thinking and enacting political and social norms of an implicit or inchoate climatic globality.

For instance, if we consider anthropogenic climate change not as an isolated (global) collective action problem, but as a social fact situated within the context of an emergent type of globality, then new connections and associations emerge. According to geologists and climate scientists (Zalasiewicz et al. 2010, 2231), it becomes encapsulated and integrated within a concept that “represents a new phase in the history of both humankind and of the Earth, when natural forces and human forces became intertwined, so that the fate of one determines the fate of the other.” Just as climate science was the precursor for the development of an Earth System science (ESS), defined as an “integrative meta-science of the whole planet as a unified, complex, evolving system beyond the sum of its parts” (C. Hamilton 2016, 94), so human-made climate change here becomes the precursor for what geologists now call a human-made

geological epoch: *the Anthropocene* (Dalby 2015; Crutzen 2002; C. Hamilton, 2016). In other words, when considering the nature of climatic globality, we can no longer think of global climate change without situating it in the context of an overarching Anthropocene epoch. Indeed, "Today, the idea of Earth as a living organism or interconnected system of natural forces figures most prominently in debates about anthropogenic climate change", note van Munster and Sylvest (2016, 8). This climatic globality is placed "at the heart of current claims that Earth has now entered a new geological epoch, the Anthropocene, defined by the central role of humanity in shaping Earth's geological and ecological processes" (2016, 8).

Global climate change is therefore framed as the essential precondition for the Anthropocene epoch, while the Anthropocene, in turn, is likewise grounded upon climate change as its conceptual foundation. The two concepts are now entwined. But what is the Anthropocene? First popularized by atmospheric scientists Paul J. Crutzen and Eugene F. Stoermer (2000), the Anthropocene implies that the Earth is now so scarred and damaged from the encroachment and abuses of humanity upon the functioning of its systems, that it has shifted out of the stable tranquility of its Holocene epoch of the past 11,500 years. Humanity's abuse is "pushing the planetary system outside the biophysical parameters that humanity has known over the last ten millennia" (Dalby 2015, 8). It makes a human mark upon the Earth's geological timescale, meaning that humanity has left a globally synchronous signal or marker across the surface of the Earth (i.e. a stratigraphic layer) and altered the operation of basic Earth systems and processes. "Human activity has clearly altered the land surface, oceans and atmosphere, and re-ordered life on Earth" (Lewis and Maslin 2015, 172).

For IR, the Anthropocene foments new demands. Not for state-led forms of governance or for renewed energies to be poured back into familiar mechanisms or institutions of international relations. Today, we read that the Anthropocene demands new forms of planetary politics (Burke et al. 2016; Biermann 2014). Here, failure is shifted from climatic governance to an all-encompassing geologic globality: diplomacy and IR, as fields of knowledge and systems of institutions, have failed "because the planet does not

match and cannot be clearly seen by its institutional and disciplinary frameworks" (2016, 501). In other words, "*IR is a malevolent ghost of the planetary real"* (2016, 512, emphasis original).

Considered in the context of these changing contours of globality, therefore, the Paris Agreement may be considered in IR in a new way: as both artifact and harbinger of the Anthropocene. Explicitly, and as noted above, COP21 was indeed doomed to fail before the conference ever began. Where this thesis project argues it succeeded, however, was on an *implicit* level: disseminating a specific form and way of thinking about climatic globality to states and their citizens. This way of thinking is one that *acknowledges human planetary agency on a new spatial, temporal, and geopolitical scale*.

In this new geopolitical context of a human-made epoch, the impact of *anthropos* – humanity – upon the Earth's climate, biosphere, and its planetary processes, overlies an implicit celebration of humanity and the human subject. "In a single lifetime we've become a phenomenal global force and there is no sign of a slowdown – in fact, our extraordinary impact on the planet is only increasing" (Vince 2014, 3). Categorical distinctions between humanity and Nature thereby lose their relevance and use when discussing the future of global politics (Dalby 2007). Global trade patterns, capital flows, and technological processes such as the Internet are now equated with Nature's planetary processes and cycles. Lewis and Maslin (2015, 178) celebrate this re-placing of humanity back to "the centre of the universe", reversing the implications of the discoveries of scientists such as Copernicus and Darwin that dissolved the image of humanity as the centre and measure of all things. On the contrary, today, these scientists declare that "To a large extent the future of the only place where life is known to exist is being determined by the actions of humans. . . . the power that humans wield is unlike any other force of nature" (2015, 178). Upon borrowing these scientific concepts and discourses, IR likewise moves beyond discussions of statist or physical security. As the centre of Nature, IR "has to be about what kind of world industrial humanity is making, and how to shape it so that civilization can persist in the new artificial circumstances of the Anthropocene" (Dalby 2014, 2). Across every discipline, therefore, many scholars

now appear all too ready to declare: "Welcome to the Anthropocene!" (Economist, 2011).

The Problem: Asserting Humanity as a Global Force

Taking a step back from this celebration of human (atmospheric and geological) agency, it is this contemporary style or mode of thinking about the Earth, and its crises of climatic and Anthropocenic 'globality' now affecting IR, that this thesis aims to problematise and explore.

To problematise is to bring "submerged problems" that are implicit in our everyday thought, up to its surface to view. It is a "practice of critique in the form of the historical problematization of the present" (Koopman 2013, 2).

When considering the present context of contemporary globality outlined above, climate change and the Anthropocene depend upon a shared conceptual assertion of human (planetary) agency. Both make the notion that humanity affects or even controls Nature into a truism. For instance, as Vince writes, "Earth is now a human planet. We decide whether a forest stands or is razed, whether pandas survive or go extinct, how and where a river flows, even the temperature of the atmosphere" (Vince 2014, 5). Or, to take a general statement from the Intergovernmental Panel on Climate Change (IPCC): "Discernible human influences now extend to other aspects of climate, including ocean warming, continental-average temperatures, temperature extremes and wind patterns " (IPCC 2007, 10); or, even within critical scholarship from IR, take the notion that in the Anthropocene "we have moved past debating the truth of global climate change and its prevention to having to think about how we are going to live in the world we have created" (2016, 505). Thus it is humanity's explicit destruction and control over the processes of the planet that is naturalised. It is evinced through the climatic globality outlined above. However, the implicit social context of this globality – that humanity is indeed a global and a planet-making force – remains tacitly assumed. The human subject becomes the inexorable destiny of Nature, so that "man is no longer just another species.

We are the first to knowingly reshape the living earth's biology and chemistry. We have become the masters of our planet and integral to the destiny of life on Earth" (Vince 2014, 7).

Once problematised, this assumption raises new ontological, epistemological, temporal, and even existential questions that have yet to be explored in IR. For instance, how did the concept of 'climate change' become a way of thinking that humanity is an agent capable of making the planet, Nature, or the Earth? How, despite IR's self-declaredly critical stance towards incorporating scientific methodologies and concepts, did natural sciences such as "Earth system science, with its powerful computer models, its massive datasets, and its complex understanding of ecological systems," (Burke et al. 2016, 504) become normalised and embraced as reflecting "the true scale and systemic complexity of the planet in a way that International Relations does not" (Burke et al. 2016, 505)?

The Argument: The Emergence of a Global Governmentality

Contrary to their use in IR, climate change and the Anthropocene are not simply concepts arising from a new understanding of transnational relations, problems of the global commons, or a newfound recognition of political globality. Nor are they objective scientific concepts or truths drawn from atmospheric and climatic sciences, or ESS, that can be nonchalantly imported and applied to IR scholarship without considering their philosophical and conceptual foundations. These concepts have a past that affects how we can use them in the present (Crist 2013).

By tracing and interpreting the historical and conceptual emergence of how we have come to 'know' these global climatic crises as integral components of our present moment, they may be understood anew: as conceptual technologies, devices, or discursive tools that evince an underlying political rationality – a style of thought, or way of rending reality thinkable – through their normalisation in our political discourse (Miller and Rose 2008, 16). In other words, climate change and the Anthropocene are

concepts that actively shape, steer, and delimit subjective thought in specific ways, bracketing some conceptual possibilities or forms of knowledge, whilst fostering others (Hulme 2009). They are components of what philosopher and historian Michel Foucault (2007) has described as governmentality: a way that one's subjective "conduct of conduct" and "management of possibilities" can be crafted and shaped without the exterior force of a sovereign or disciplinary power determining its action from above (Foucault 2002a, 341).

The primary argument of this thesis is that the concepts of climate change and the Anthropocene reveal a new form of global governmentality. It emerged only recently from an overlap and crystalisation of nuclear sciences, technologies, and state practices. Yet, it is a form of global governmentality grounded not upon familiar and well-tread IR notions of security, population, society, the state, nor even (neo)liberalism (see Neumann and Sending 2010; Joseph 2012; Corry 2013; Vrasti 2012; Walters 2012). It is instead grounded on a new type of global scientific process that captures and orients life in very specific ways today. This type of global governmentality transcends new scales, spatialities, and even temporalities. It ranges from atomic to global levels, and from the linear seconds and hours of the 'clock time' of statist Western modernity, to the deep geological time of Earthly epochs. What grounds and sustains this new form of governmentality? Underpinning the conceptual foundations of climate change and the Anthropocene, it is most visible in practices tracing and politicizing "a part of all living matter on Earth" (Lövbrand and Stripple 2006, 217), as something "put into the atmosphere by anyone, anywhere on the Earth [that is] globally atmospherically circulated" (Deudney and Mendenhall, 26). It is what is commonly accepted as the essence of the human being, organic matter, the climate, the Earth, and all life itself: *the carbon atom*.

From this tiny atom, a "global calculation . . . a new form of global rationality, of a new calculation on the scale of the world", emerges (Foucault 2008, 56). It ties the essence of each human subject, with every breath exhaled, to the social and global crises of globality noted above. Through carbon, humanity may thus be directly related to every

'thing' as both a creator and destroyer, steward and master. It conducts conduct through subjective *relations*, or by the enmeshing and relating of the human subject to every potential referent through this carbonic connection or entanglement, rather than by institutional or governmental dictates or regulations typically exposed through governmentality analytics in IR.

This new understanding of (global) governmentality and its carbonic or atomic subjectivity leads to the second argument of this thesis. Rather than the governmentality described by Foucault and embraced in IR, the sciences of GCMs and ESS fosters a political rationality grounded upon, and disseminating, a metaphysical subjectivism. It is what is defined here not simply as governmentality, but as 'relationality'.

What is relationality? It refers to how, through the spread and adoption of Western scientific concepts such as climate change, "Every relation to something—willing, taking a point of view, being sensible of something—is already representing; it is *cogitans*, which we translate as 'thinking'" (Heidegger 1977b, 150). Relationality fosters a technological form of subjectivism through the adoption and use of its concepts. These delimit the boundaries of subjectivity, in a way that each subject re-presents the world back to itself, as an object, or world picture: "What is, in its entirety, is now taken in such a way that it first is in being and only is in being to the extent that it is set up by man, who represents and sets forth" (Heidegger 1977b, 130). In other words, this world picture orients every thought as a *relation* between a human self as a Cartesian 'I', and that to which the thought relates to, as its object (see chapter 2). Nowhere is this clearer than in the concept of the Anthropocene, where the human subject globalises the essence of its own life – the carbon atom – through the projection and calculation of planetary processes. "In the planetary imperialism of technologically organized man, the subjectivism of man attains its acme," wrote Heidegger (1977b, 152), "from which point it will descend to the level of organized uniformity and there firmly establish itself." It is in understanding *anthropos* as maker and master of both climate and Earth, that relationality underpins globality.

Indeed, in defending this secondary argument, this thesis observes how Foucauldian analytics of governmentality are closely related to the analyses of Western metaphysics, science, and technology, as described by Heidegger (1977a; 1977b) and Hannah Arendt (1998; 2006). Hence, the insights from these philosophers are used alongside and at times even combined with, governmentality analytics. Taking care not to 'Add Foucault and Stir' (S. Hamilton 2014), the project ensures that their philosophical claims and foundations are congruous and consistent in order to defend its primary arguments. For instance, whilst Foucault's accounts excel in describing how the constitution of subjectivity can be shaped within established limits or boundaries so as to facilitate governance (i.e. by and through the state; the grid; the subject; etc.), the technological metaphysics of Heidegger and Arendt are able to describe how these 'bounds' or thinking 'subjects' are first able to be 'thought' of or cognised at all (see Elden 2001).

Although delving at times into geography, natural science, and ecological thought, this thesis project should ultimately be considered as a work of IR theory. Its theoretical tools and methodologies are derived from philosophers that excel in detailing how science, technology, and the concept of cycles and processes, intersect with life and politics in modernity or postmodernity. It thus hopes to make a contribution to IR and the social sciences by highlighting new and fruitful ways of approaching the analytical tools of genealogy and (global) governmentality. IR has forgotten how the concept of governmentality itself emerged from the application of scientific rationalities to Nature, in that, "what characterizes this new art of government [governmentality] . . . would be much more a naturalism than a liberalism" (Foucault 2008, 61). In a like fashion, this project analyses how the sciences of ESS shape our own political rationalities in the present moment when they are applied to scales and forms of life other than bodies within a nation-state: in this case, it is processes of carbon on a global scale.

The chapters below trace the history of how this climatic global governmentality emerged and was facilitated through these concepts of climate change and the Anthropocene, concretising in the relationality steering our thought and conduct today. It begins with an analysis and interpretation of the sciences and technologies used by the

state since 1945 to bring the 'global climate', and then the Anthropocene, into being: computerised simulation models known as 'general circulation models', or GCMs. It then moves on to describe the practices, rationalities, and everyday concepts with which this global governmentality is now entwined today, within our own conduct and subjectivity.

What this thesis aims to do (and not to do)

As Foucault once phrased it, "People know what they do; they frequently know why they do what they do; but what they don't know is what what they do does" (quoted in Dreyfus and Rabinow 1983, 187). The chapters that follow are thus an attempt to combine philosophy with empirical research into climate change, carbon, and the Anthropocene, with the purpose of highlighting for IR what our conversations about these concepts are *doing* today. This thesis, therefore, aims to diagnose what thinking about climate change and the Anthropocene in IR, *does*.

It must be stated that this thesis is not intended as a traditional 'history' of climate change, the Anthropocene, nor of globality (see Fleming 1998; Weart 2003; Stevens 1999; Edwards 2010; Kahn 2014; Bartleson 2010). Histories of these concepts would require an immense literature review across both the social and natural sciences, and hence it is beyond the scope of this project (see chapter 2). With its genealogical impetus, it instead aims to examine our present moment rather than claim to shine a light on the past.

Likewise, this thesis is not a critique or rejection of the sciences and technologies examined herein, nor does it dispute the findings and research indicating that anthropogenic climate change is unequivocal (IPCC 2013). It agrees that humanity's impact upon the Earth's systems and processes might be so deleterious and damaging, that they could leave a stratigraphic mark upon the planet, or transform the Earth's systems. In other words, it does not dispute the seriousness of global climate change, nor the Anthropocene epoch, for the future of the planet. As Foucault, Heidegger, and

Arendt would agree, the sciences that calculate and quantify Nature as bounded forces now able to be harnessed by humanity, are indeed incredibly powerful. Technology surely provides benefits to humanity in countless ways, and has been increasingly imbricated in studies international politics (see Skolnifoff 1993). Rather, the goal here is to critique how the particular truths underlying climate change and the Anthropocene – i.e. humanity's impact upon, and future stewardship of, the Earth – came into being, and how these concepts are used in IR today. The aim of this thesis is, therefore, to analyse how the conceptual underpinnings of climatic globality shape our thought. This should not be misconstrued as an attack on the scientific, normative, or ethical implications derived from them (see chapter 8).

Genealogical Methodology and Methods

This thesis offers a theoretical and philosophical analysis of how the concepts of climate change and the Anthropocene have emerged over time, and it interprets what it is they do to subjectivity when they are thought. Although its genealogical methodology is outlined in detail in Chapter 2, it is important to distinguish here at the outset of this project the differences between its overall methodology and its *method*.

Generally put, whilst a methodology is the background philosophical context through which research takes place, its method is the concrete application of these philosophical principles to the world in order to acquire information or data about it. As succinctly phrased by Jackson (2010, 25), "methods are techniques for gathering and analyzing bits of data, whereas methodology is 'a concern with the logical structure and procedure of scientific enquiry'." Indeed, when this thesis is viewed as a whole it provides a clear methodological procedure illustrating how its genealogical revelations were arrived at. Yet, how it arrived at its specific method and the distinct topics explored in each chapter, and the flow between the variety of topics problematized in chapters 3 to 6, differs from this methodology and so must be elaborated here. The point is that the (seemingly, at first) distinct topics and historical problematisations comprising chapters 3 to 6 were in no way random, nor selected haphazardly. They were chosen after the

author of this thesis attended a unique and specific event in London, 2015 (see below), that served to concretise the important research questions and topics explored in this thesis thereafter. This event must be elaborated upon briefly in this introduction, so the distinct topics, research questions, and hence historical methods engaged in chapters 3 to 6, can be fitted within the overarching methodology of this project.

As Kendall and Wickham argued in their guide *Using Foucault's Methods* (1999, vii), "First of all, it may be suggested that there are no such persons as 'Foucaultians' and that there is no such thing as a 'Foucaultian method'." Although Foucault's methodology was typically a nominalist genealogical critique of tacit or everyday referents and assumptions, his method constantly changed depending on the problem he was examining and the resources and texts he had available to contribute to his historical analysis. Indeed, when considering method, a genealogy is inexorably a contingent and personal event: it is always simultaneously constrained *and* freed by the subjective limitations and possibilities a researcher has at hand as they engage their genealogical methodology in their present moment. In the case of this thesis, the distinct topics of chapters 3 through 6 and the historical *method* used in each to collect the information fitting within its overarching methodology – i.e. the genealogical and historical problematisation, practice, rationalitiy, and emergence, of climatic globality – was shaped and determined by an event on 8-9 January, 2015, at King's College in London, UK. This event, 'UK Climatology 1960-1985 and the Emergence of Climate Modelling'[3], was a private and invite-only gathering featuring influential figures in the history of the digital and computerised simulation models of the climate. Climate modellers included John Mitchell and Peter Rowntree of the UK's Meteorological Office, Lennie Smith of the LSE and the University of Oxford, and even the prominent Phil Jones of the University of East Anglia (perhaps most notable for his central role in the 2009 event known as 'Climategate', or the hacking of emails of climate modellers in an attempt to manipulate their conversations so as to discredit their epistemic

[3] This event was held 8-9 January, 2015, in the River Room of the King's Building (Strand Campus) of Kings College London. It was part of the international project '*Shaping Cultures of Prediction: Knowledge, Authority and the Construction of Climate Change*' that was coordinated by Dr. Mathias Heymann (Centre for Science Studies, Aarhus University).

community as malicious or conspiratorial). The purpose of the event was to gather world-leaders in climate science and modelling – especially those contributing to and influencing the historical development of its computer models and codes – to discuss the nature and emergence of climatic knowledge, its competing epistemic cultures, its technologies, and how the predictive tool of the 'general circulation model' came to be fraught with such controversy; even as it became the dominant global research strategy for climate science and atmospheric fluid dynamics. Throughout this event, geographers, sociologists, and historians of science discussed their own intimate involvement with, and thoughts on, the development of climate models and the rise of 'global climate change' to its current status of a crisis of global governance. The end of the event culminated in a discussion of the climate's relation to the concept of the 'Anthropocene era'.

Upon hearing the rare conversations and insider debates taking place amongst this notoriously attention-shy community of climate scientists, four central themes emerged. These themes, and the research question(s) engendered by each, would thus become the pieces forming the overall methodological focus of this thesis: first, the history of Cold War and nuclear sciences developing alongside climate models; second, the relationship of GCMs to political speech and action, and how they could be reconciled; third, the apparent intractability of complex communicating modelling data and results to international political audiences at the level of state and global governance; and finally, the climatic emergence and modelling of the Anthropocene epoch as the next stage of Earth system science and climate modelling. Hence, because "the prime method for any researcher inspired by Foucault is an historical method" (Kendall and Wickham 1999, 60), the historical problematisation of each of these four central themes came to occupy and fill the methodological contours outlined in this thesis. They were selected based upon the intimate discussions of this select group of climate modellers, scientists, and historians, and which were also reiterated at a similar event in February, 2016.[4]

[4] This latter event was entitled 'Climate change and the art of the (politically) possible: climate governance and the Paris Agreement', and took place 24 February, 2016, at King's College London. Although directed more towards the critical social sciences and the recent COP21 climate conference, this

Positionality: the subject remains, not as 'I' but as *subiectum*

How is this thesis positioned in relation to works of critical IR scholarship that have recently engaged with climate change and the Anthropocene? In short, it disagrees with the philosophical stance of a large majority of this literature, which asserts climate change and the Anthropocene to indicate humanity's obvious entanglement, enmeshment, or relational attunement with Nature and the Earth (see Burke et al., 2016; Harrington 2016).

By adopting frameworks of 'new materialism' or derivations of Actor-Network Theory (ANT) (see Latour 2016; Salter 2016), this group of critical IR scholars[5] asserts that global environmental crises evince and demand a new understanding of materiality and agency that overcomes outdated modernist binaries of subject/object, nature/culture, mind/body, individual/state, etc. In other words, critical IR scholarship now assumes that the Anthropocene inexorably demands a flat or relational ontology, leading towards a new 'human condition' (Grove 2015). What this implies, however, is that any interpretation of the limits of human thought, or critiques aiming to expose the historical and social boundaries of human subjectivity – i.e. the considerations commonly ascribed to continental philosophy – are labeled as anthropocentric, outdated, or even indicative of the modernist binaries that IR must now eschew in favour of embracing its new material entanglement with Nature. Examining the constitution of the human subject is thus discouraged. Rather, the point becomes to privilege networks and overlaps of matter and materialities, and the ethical responsibilities to respect and steward them: "all entities – whether it is atoms or governments – stand on equal ontological footing to begin with. The associations established between them make the difference of whether one becomes more powerful than the other" (Müller 2015, 30). In sum, these attempts at eliminating subject/object binaries is assumed to be imperative in order for IR to

event subtly repeated the same themes of the earlier 2015 conference. It thus served to affirm the topics and historical content explored in chapters 3-6 of this thesis.

[5] It should be noted that IR's engagement with the Anthropocene is very new, and hence this thesis engages works such as Burke et al. (2016) and Harrington (2016) consistently because they are the frontrunners of what is increasingly emerging as a subfield of critical IR.

embrace humanity's material entanglement with Nature and Being. Discussions of climatic globality thereby become a way of understanding and asserting this blurring-together of humanity and Nature, subject and object, so that the 'self' and the 'other' fade away (Harrington 2016).

Critics of these new materialist approaches to politics and IR lament how they collapse history, culture, tradition, and social context, into networks of materiality that ignore the intangible historical and social construction of human subjectivity. Rather than only binaries of subject/object or culture/nature, it is also race, power, religion, history, and the intangibility of thought, that also incidentally fades away. The constitution of thought and subjectivity is taken as a vestigial effect, or an anthropocentric aftershock, of overlapping networks and relations of matter. As a result, because every 'objectification' of thought is pre-ordained by this group of scholars to be an anthropocentric and epistemic violence against Nature, an ethical affirmation or entanglement *with* Nature simply replaces socially-derived and "logically informed analysis of the conditions of objectification, and thus, of their contestation" (Rekret 2016, online). Although this thesis agrees with this critique – in that social and historical context is crucial for understanding thought, action, and politics today – it expands upon it in the chapters that follow, by considering anew its metaphysical roots. As noted above, this involves differentiating between subjectivity as an 'I', and the subject in-itself, as '*subiectum*': that-which-lies-before. It argues that critical IR scholarship embracing concepts of 'entanglement' from new materialism and ANT has actually conflated the I and the subject, thereby replicating the very metaphysical subjectivism always contained within Western subject/object binaries (see chapter 6). However, what is meant by these terms, 'subject' and 'subiectum'?

Take, for example, the recent 'Planet Politics Manifesto' (Burke et al. 2016). To be clear, this is a genuine, creative, and important and commendable text in critical environmental IR. It lays out a groundbreaking style and agenda for disciplinary and social change pertaining to looming environmental crises and catastrophes. However, at a conceptual and philosophical level, it embraces and exacerbates the tacit metaphysical

subjectivism and *celebration* of humanity that this thesis aims to expose and critique. As such, the 'Manifesto' is used throughout this thesis to exemplify the metaphysical subjectivism implicitly produced in IR's critical climate and Anthropocene discourses. For instance, and echoing established critiques of new materialism's rejection of social power relations, the manifesto eschews historical and social accountability since "we need not focus on who is responsible [for the global ecological crisis]" but must work to protect the Planet through a politics of entangled Being (Burke et al. 2016). It asserts that a "new consciousness is visible" now, because in the Anthropocene, "The Other is always already inside, so bound up with us in a common process that it no longer makes sense to speak of inside and outside . . . This may finally be the death of Man, but what will come next if this face is lost in the rising tides?" Throughout the manifesto's list of ten commandments or goals – from the transformation of the 'being' of man to calls for a global ethics – the human subject, assumed to be the ego or I, is framed as being assimilated or rendered facile by new, relational, object oriented ontologies, in an increasingly pressing climatic and Anthropocene entanglement. So, "no being is truly autonomous or separate, whether at the scale of international politics or of quantum physics." As noted above, and as will be explored throughout this thesis, this is indeed the general position of critical IR's engagement with climatic globality and the Anthropocene.

To repeat once more: the position of this thesis is that these claims for Anthropocene ethics and entanglements conflate the human 'I', with the concept of 'subject', mistakenly eliminating the consideration of the latter by discounting the former. In doing so, and in rejecting historical and metaphysical accounts that trace how specific social practices and conditions shape specific modes of thinking, or rationalities – including those shaping how the 'I' came to be – they also mistakenly reject the notion of subject, and hence, of object. In other words, the I is mistaken as the *only* possible grounds for subjectivity. Why is this an issue? Quoting Heidegger (1977 128): "We must understand this word, *subiectum*, however, as the translation of the Greek *hypokeimenon*. The word names that-which-lies-before, which, as ground, gathers everything onto itself. This metaphysical meaning of the concept of subject has first of

all no special relationship to man and none at all to the I." As will be explored in the chapters that follow, the attachment of the *subiectum* to the 'I' was a recent historical event culminating in Cartesian philosophy and a calculative representationalist metaphysics that placed one's self-certainty not as a being-in the presence of things, Gods, groups, chains of Being, etc., but in the modern ego or I as the new foundation or *subiectum* (see chapers 2 and 6). Therefore, when critical IR scholarship now conflates the I with the subject and asserts the ontological primacy of matter over any subject/object binaries, it ignores how the *subiectum* is not actually limited to the I, but can (and has) actually shifted *away* from it, towards a new grounds for certainty: a new metaphysical *subiectum*. In the social and historical transformations spurred by today's emerging climatic and Anthropocene globality, this *subiectum* is in fact emerging as something else entirely. Indeed, as this thesis argues, the new sense of certainty and security within our epoch-making global crises of climatic globality belies an assertion and formation of the 'We' of the human species as *subiectum* (for instance, see Chakrabarty 2009, and chapter 7).

Although this thesis is sympathetic to the genuine desire of critical IR scholarship to foster a healthier or more secure climatic globality, it ultimately disagrees with its bracketing of the social and historical conditions that shape human thought and subjectivity. This results in discourses mistakenly asserting the ontological primacy of entangled materiality over the historical and social transformations that continue to shape thought and subjectivity today, yet which remain detectable through genealogical inquiries such as the one conducted here. The position of this thesis, therefore, is not one aiming to celebrate or 'save' the I, ego, or individualism from critique or dissolution. Far from it. Rather, the positionality of this thesis stresses that the *subiectum* can and does change metaphysically and historically across time, and these unexpected moments and events of transformation are to be critiqued and engaged – precisely in and through the application of genealogical methodologies to the recent emergence of climatic globalities, and concepts such as the Anthropocene.

Overview of Chapters

This thesis will now proceed as follows, expanding upon the general arguments and issues touched upon in this introductory chapter.

Chapter 2 begins with a theoretical and methodological overview of the theories and philosophies used in this project: genealogy and governmentality. A description of genealogical methodology is thus set forth, highlighting what this thesis identifies as four crucial stages for every genealogical analytic: problematisation, practice, rationality, and emergence. This genealogical framing grounds each of the chapters that follow in this thesis, in that each chapter represents one of these key stages in a genealogy.

Whilst genealogy provides the methodological impetus and framework of this thesis, it is governmentality that best diagnoses how and why these twists and turns in carbonic climate discourses occur. Hence, chapter 2 also explores IR's ongoing 'global governmentality debate', arguing that the discipline's literature reifies neoliberalism by asserting its global presence as an *a priori* foundation for analysis. It argues that governmentality is not limited solely to diagnoses of liberalism, but is coeval with the metaphysical demarcation of Being and subjectivity best explicated by Martin Heidegger's (1977a) concept of technological 'enframing', and his description of technology fostering a subjectivist world picture (1977b). This opens the possibility for forms of global governmentality to be conceptualised through the global spread of Western science and technology, as evinced in later chapters of this thesis through GCMs and ESS, as well as in the framing of the concepts of climate change and the Anthropocene. Enframing, in other words, governs contemporary governmentality, and the technological subjectivism or 'relationality' we see in climatic discourses today.

Chapter 3 deals with the *problematisation* of climatic change in our modern era. It begins with a short literature review of historical and recent texts that situate 'the climate' throughout Western history. This establishes the reader within contemporary

mainstream and critical accounts of how and why we have come to 'think' of the climate as we do today: as a global object or entity, which is now assumed even by critical scholars and geographers as "a privileged analytical entry point for interrogating the connection between globality and the Anthropocene in more detail" (Randalls 2016, 146). This is not, as might be commonly assumed when mentioning the words 'history' and the climate, an examination of carbon dioxide (CO_2) per se. Rather, it is a genealogical tracing of the development of the technologies that bring the climate into being as a thinkable and knowable object: GCMs, and their development in nuclear physics and research into atomic weaponry after World War II. This chapter reveals how the surprising emergence of anthropogenic 'global' climate change came not from environmental research nor from the natural sciences, but from investigations into nuclear fallout and later prognostications of a global nuclear winter; concepts that first popularised and spread the notion that humans could impact their planet globally, and be impacted, as 'one world'.

Chapter 4 examines in greater detail the *practice* of how the climate is brought into being through GCMs. Despite these GCMs delimiting clear global climatic threats noted in chapter 3, even up to our present moment, there are increasing lamentations over the lack of collective and individual "action" concerning this climatic threat. COP21's Paris Agreement is only one example of many. Thus, by examining how the global climate is manifested through the GCMs used by the Intergovernmental Panel on Climate Change (IPCC) in greater detail, this chapter isolates the practice of bringing the climate into being as a type of metaphysical enframing, described by Heidegger (1977a). Once enframing is determined as the technological essence of the GCMs disclosing the climate, then the conceptual essence of climatic globality is argued to be contradictory to forms of social and subjective thought required for substantive political action. In other words, the concept is constructed by GCMs in such a way that it blocks or prohibits the unpredictability required for political debate and action. Hence, the failure of climatic governance and the spread of a concept of climate that is, conceptually, antithetical to substantive political action. Paradoxically, the failure of governance indicates the success of this enframed concept.

With this failure of political action and governance demonstrated to be inherent to GCM technology, chapter 5 interprets and elaborates how the political *rationality* underpinning the concept of climate change is enacted internationally. Following from chapter 4, it notes how inaction in global climate governance is referred to as a failure. Yet, this ongoing failure raises an important question: if international collective action is required so as to heal, fix, or prevent further damage to the climate, was there ever a concept of the global climate that was not damaged, broken, or in need of international governance? This chapter reveals how our naturalized concept of a 'global' climate actually emerged in international relations only as recently as the late-1980s, framed from its outset as an always *already* broken or damaged object resulting from failures of governance to steward the Earth. It is thus an implicit 'rationality of powerlessness' that emerged alongside notions of the global climate since its international political inception; from the 1979 World Climate Conference, to its global spread in the mid-1980s by the Intergovernmental Panel on Climate Change (IPCC), to its naturalized meaning today. Thinking of climatic globality, therefore, has always pre-emptively framed the human subject as something ineffectual or powerless against the climate.

It is at this point in the genealogical tracing of this thesis project that our contemporary global political rationality emerges: when GCMs are applied to ESS, they give rise to the concept of the Anthropocene and a globalised and carbonic notion of the human self. Combining the insights from chapters 3-5, chapter 6 details how the climatic and technological underpinning of the Anthropocene builds upon the carbon of climatic change, to manifest a new and global form of biopolitics and governmentality. As noted above, this rationality asserts the essence of all (human) life and industry — the carbon atom — as the measure and centre of everything. When Nature becomes pre-reflectively projected, quantified, and conceived as a calculable and carbonic human construction, then every thinkable object becomes related back to the human as its creator and steward in a powerful form of subjectivism: a global governmentality as relationality. As such, chapter 6 can be considered as the 'keystone' of this thesis project.

From the emergence of this carbonic relationality in the Anthropocene, Chapters 7 and 8 then use this genealogical insight to diagnose and interpret how we 'think' about climatic globality within our present moment. First, chapter 7 analyses how the concept of the Anthropocene transforms our understanding of temporality. Although the spatial reach of the Anthropocene across the globe is assumed and often discussed, its temporal reach across geologic or 'deep time' has not been examined in IR (on time, see Hutchings 2008). However, if the common claims that we are entering an Anthropocene epoch are taken seriously and adopted, then our tacit and naturalised understandings of political and human time, temporality, and history, must be irreparably transformed in turn. Politics and IR, however, are not equipped for deep time as such. Hence this chapter argues that the globality of the Anthropocene's deep time effectively ends human time and history as we know it. It fosters a new eschatology and cosmology of human influence over the cosmos, re-asserting its own subjectivism into deep time, as the measure and centre of temporality. It takes the Anthropocene's establishment of a 'golden spike' as a global marker that is both human, and within deep or geologic time, replacing what Christ's birth represented for modern Western, human, calendrical clock time. As years are replaced by epochs, however, humanity can now only relate to itself as a species (Chakrabarty 2009), and so once again the spectre of the Anthropocene as Heidegger's portent of the planetary imperialism of technologically organised man, is raised (1977a).

Chapter 8 analyses IR's recent incorporation of security into Anthropocene discourses. It argues that its most prominent impact on IR today comes not from predicting or hazarding looming physical threats or violent future conflicts. Instead, it threatens our present *ontological* security: our deep and normalised conceptions of humanity and what it means to be a human 'self' in a stable and continuous world. By replacing the foundation of ontological security in modernity – the uncertainty of death – with a new uncertainty of *anthropos* – grounded on relationality as an existential discontinuity, borne of our own human selves – the Anthropocene manifests the need to secure humanity from humanity. It is what this chapter describes as the Paradox of the Anthropocene, or the task of securing oneself *from* oneself. Attempts to re-instill the

certainty of a stable human self within an uncertain Anthropocene epoch become evident when considering IR's recent import and reification of the concept of 'entanglement' from quantum physics and sciences. Entanglement is a form of order that once again makes certain the human self's relation to Nature. However, by examining the discrepancies between Anthropocene globality, and quantum science and entanglement, this chapter also argues that what emerges in Anthropocene security discourses is a dis-entanglement from Nature. Concurrent with the overall findings of this thesis, it diagnoses these calls for an ethical entanglement as overlying a relationality positing a human interconnection with everything. It is an attempt to secure a consistent sense of self, in an incalculable and otherwise insecure future epoch.

Finally, this thesis concludes with a brief overview of this project, and what its arguments imply for IR and the social sciences going forth. It discusses some of the limitations inevitably encountered in its research, the implications that its conclusions have for IR as a discipline, its impact on established scholarly literatures, and the potential it creates for future research into new forms of climatic globality. It also discusses the potential for a new methodology of 'global genealogy' that could work well with the form of global governmentality embraced throughout this project.

Chapter 2 – Genealogy, Governmentality, Technology: De-naturalising Globality[1]

Introduction

This chapter details the methodological and philosophical foundations of this thesis.

It has two aims. First, its methodological goal is to elaborate the genealogical framework that structures the overall argument of the thesis. A methodology is considered here as a logical structure and procedure for the conduct of inquiry, or for how an investigation into a 'world' can 'hook-up' to that world (Jackson 2010). Since this thesis inquires into a world comprised of the conduct of conduct – i.e. subjectivity, and its social and historical emergence – it selects as its methodology what Michel Foucault called genealogy. It begins by reviewing four key steps or components to conducting a Foucauldian genealogy, with each step linking up to corresponding chapters that follow. These steps involve the problematisation, practice, rationality, and emergence, of the concepts of globality that were noted in chapter 1.

Second, this chapter elaborates the philosophical arguments contained within each of the following chapters. Each chapter varies somewhat in its use and combination of Foucauldian, Heideggerian, and Arendtian philosophies, depending on the specific problem being examined therein. In other words, each individual chapter appears unique when examined closely, as a self-contained piece of the overarching puzzle of this project. Foucault, Heidegger, and Arendt are engaged in different combinations and ways in a bottom-up fashion, depending on the question being examined. Yet, upon stepping back to view this overall project as a whole, each argument ultimately contributes to a coherent and concise genealogical rendering of the globality of climate change and the Anthropocene.

[1] Sections of this chapter are published in Hamilton, S. (2017). A Genealogy of Metatheory in IR: How 'ontology' emerged from the Inter-Paradigm Debate. *International Theory*, 9(1)., pp. 136-170; Hamilton, S. (2016). The measure of all things? The Anthropocene as a global biopolitics of carbon. *European Journal of International Relations*, (online) pp. 1-26.

In pursuing its second (philosophical) aim, this chapter also makes a novel contribution to IR and global governmentality studies. It establishes the groundwork for a form of global governmentality that is based upon technological metaphysics. This contributes to the discipline of IR and the social sciences by freeing governmentality from its dependence upon discourses of (neo)liberalism, thereby opening a wide variety of potential processes and rationalities that future practitioners of governmentality studies may pursue. It does so, first, by stressing the relevance of genealogy to governmentality analytics. Second, it then distinguishes governmentality from its recent conflation with liberalism, by revisiting the work of Foucault in which he first developed this analytic (2007). This move reveals how governmentality emerged from discourses of Nature, when scientific and technological processes were applied to the territory of the state. Hence, if governmentality first emerged when scientific processes and mathematical forms of physics were applied to processes of life and to the state, then there is no reason that new (or as yet, undetected) forms of governmentality do not exist in similar ways and fashions, unbeknownst to scholars today.

In arguing these points, a synthesis of governmentality with the continental philosophies of Martin Heidegger and Hannah Arendt, is thereby made possible. Whilst the former excels in analysing the historical constitution of the human subject in relation to (meta)physics, technology, and the nature of worldly Being (see Heidegger 1962; 1977a; 1977b), the latter excels in situating this technological metaphysics as a medium for political action and inaction in modernity (Arendt 1998; 2006). As noted in chapter 1, Heidegger's concept of technological 'enframing' and the way in which it projects and establishes the boundaries of subjectivity is reminiscent of Foucault's description of governmentality. Arendt's work is thus able to connect Heidegger's technological metaphysics to Foucauldian social frameworks, and notions of power and subject formation, in ways complementary to governmentality analytics (see Dolan 2005; McWhorter 2003; Dreyfus 2003). Whilst enframing 'governs' governmentality, Arendt's insights into the historical constitution of the social connects this technological focus with the workings of the human condition.

The remainder of this chapter will now engage genealogical methodology, governmentality analytics, and the philosophy of Heidegger and Arendt, in greater detail.

Conducting a Genealogy

Most commonly associated in IR with Foucault (Vucetic 2011), a genealogy is a way to analyse, historicise, and denaturalise commonplace or immutable practices, subjects, objects, referents, and truths. In showing how forms of knowledge and meaning that are considered to be universal or obvious are actually temporal and historical, a genealogy thereby opens the possibility for transcending the limits and boundaries that these concepts create in our contemporary styles of thought. If an ahistorical universal is historicized and re-conceptualized as being temporal and malleable, then the possibility to think and do otherwise than what came prior to its genealogical analysis, is created (Walters 2012, 118; Saar 2002, 233; Bevir 2008; Foucault 1991, 2000a).

In this thesis, four key stages in genealogical analytics will be highlighted and explored. Each stage occupies its own chapter: problematisation (chapter 3), practice (chapter 4), rationality (chapter 5), and emergence (chapter 6). Yet, prior to exploring the meaning or purpose of these stages, it is crucial to ask: what is the point of actually engaging in a genealogical analytic? Why not engage in a simple historical reading of past historical texts on climate change or the social construction of the globe (see Bartelson 2010)?

A genealogy is conducted because it avoids the twin fallacies of what are labeled here as ‘presentism/finalism’. Presentism occurs through the unintended projection of our contemporary discursive meaning(s) into the past, thereby mistaking present referents as being coexistent or contiguous with the past. Finalism occurs by accidentally (pre)determining or assuming the historical development of a current referent as developing along a progressive or linear teleological path, from a kernel or germ in the past into its present and immutable form (Bartelson 1995; Dreyfus and Rabinow 1983).

Unbeknownst to us, these implicit presentist/finalist ways of thinking invariably determine how our current concepts, knowledge, and thought, conceptualizes our world(s).

Indeed, the most prominent histories of climate science, climate change, and the Anthropocene typically develop their concepts along a similar and shared linear trajectory. What is considered to be important in each account is pre-determined from today's present standpoint, then projected into the past, and then developed up to its fulfillment in the present moment. Seemingly without fail, each history reminds readers of a very familiar narrative: that in the early nineteenth century, Joseph Fourier recognized that the Earth's atmosphere retained heat radiation; in 1859, John Tyndall realised this warming was controlled by the accumulation of CO_2 gas; in 1896, Svante Arrhenius first developed a theory of 'greenhouse warming' in which an accumulation of anthropogenic CO_2 emissions could warm the Earth's atmosphere; that this theory was eventually traced and expanded upon by proceeding generations of scientists and geologists, such as Guy Stewart Callendar in the 1930s; that after World War II, the Cold War allowed meteorological and climate scientists to expand their research into the atmosphere in new ways, finally allowing Charles D. Keeling to document clear and increasing atmospheric concentrations of atmospheric CO_2 from an observatory in Mauna Loa, Hawaii, giving rise to the infamous 'Keeling Curve'. And the rest of this well-known story of climatic globality, as the expression goes, 'is history' (see Fleming 1998; Weart 2003; Stevens 1999; Bolin 2007).

Although valuable and informative, these are histories of the past from the presentist/finalist perspective of our present moment. It is this perspective that this project aims to avoid. The point of a genealogy, rather, is not to target the past from the present, but to target the present moment itself. A genealogy looks not into bygone times, but into a mirror. This "radical historicism" works by establishing "delegitimizing, denaturalizing perspectives on the processes of subject constitution and construction" (Saar 2002, 237). In other words, the point of a genealogy is to uncover a surprising history about the foundations of our own naturalized style of thinking. By

revealing how everyday concepts previously assumed to be banal or without history actually emerged into being unexpectedly and contingently from forgotten problems and events, conclusions previously un-thinkable prior to the genealogy taking place, may thus emerge.

As Biebricher has noted, it is impossible to review every single one of the numerous studies invoking genealogy, and Foucault's own inconsistent use of the term makes a genealogical method "difficult to pin down" (2008, 365). Simply put, there is "no single genealogical method" (Walters 2012, 7). That being said, this chapter will now offer an heuristic guide for conducting a Foucauldian genealogy, using four steps exemplified by the chapters that follow: problematisation, practice, rationality, and emergence. As such, this chapter, and this thesis, is not an ironclad declaration of what every genealogy was, is, should, or can be. It should be considered as a recipe or toolkit that scholars may draw upon in the future when conducting their own.

(a) Problematization

A genealogy begins by selecting a commonsensical or naturalized truth – a referent from the present – to be "problematized" (Foucault 2000b; Hoy 2008, 276-81; Koopman 2013). This involves the challenging task of considering its current, universal, or taken-for-granted form, as a contemporary solution to a forgotten problem. What we have to do with our everyday assumptions, or the "banal facts" of our referent's obvious truth, is to "try to discover—which specific and perhaps original problem is connected to them" (Foucault 1983, 210). The genealogist's task, therefore, becomes "to grasp the general form of problematization that has made [the referent] possible" for us to think about in the present, in its current "historically unique form" (Foucault 2000a, 318). With no universals allowed, the initial questions of a genealogy thus become: What problem once existed to which this referent was a solution? And after it had emerged into thought and being, how did it become the axiomatic or commonplace referent we think of today?

This thesis has selected the globality of climate change and the Anthropocene as referents to be problematized. Hence, what underlying problem allowed these concepts to emerge in IR, and to assume the naturalised global form(s) in which scholars understand them today? This underlying problematisation will be explored in chapter 4.

(b) Practice

Secondly, every genealogy should select a form of practice within which its problematized referent is commonly embodied or materialized in thought and discourse. For Foucault, thought – or thinking – is always in process as an endless interplay of delimiting truth/falsity, right/wrong, good/bad, etc., and it is what constitutes our 'knowledge' about anything. Knowledge, as a collection of accrued thought(s), channels and manifests thought into 'action', or behavior that becomes visible on the surface of a practice. A material, socially meaningful pattern or "system of action" is thus inhabited by this ongoing interplay of thought and knowledge (Foucault 2000c: 201).

In being enacted empirically "in and on the material world", a practice thereby makes visible the discursive background conditions that imbue its associated referents with meaning (Adler and Pouliot 2011, 4). A practice makes intangible knowledge visible (Neumann 2002). If interpreted carefully, therefore, a practice may act as a window to the constitution of subjectivity underlying it. A genealogy thus proceeds through "the *problematizations* through which being offers itself to be, necessarily, thought – and the *practices* on the basis of which these problematizations are formed" (Foucault 1992, 11, emphasis original).

For instance, in discourses of climate change and the Anthropocene, it has become a truism that atmospheric cycles and processes – especially those of carbon and CO_2 – are axiomatic considerations when discussing global environmental change and governance issues. Indeed, climate change is "by its very nature a global problem . . . [and] mitigating global climate change can only be achieved efficiently through international collaboration" (Luterbacher and Sprinz 2001, vii). "'Solutions' to putatively global

problems have figured multiple, often competing views of agency and power at many scales", claims Edwards (2016, 189). And yet despite this supposed variety of global scales, it is always "*carbon* accounting for self-monitoring individuals; *carbon* trading in national and international markets; *carbon* taxes imposed by governments on corporations and consumers; or military concern with *climate change* as a threat to international security" (emphasis added), to which scholars gravitate. Therefore, it is this practice of bringing cycles of carbon into being so as to be politicized climatically – i.e. made possible to enter politics, through the complex technologies of GCMs – that is explored in chapter five.

(c) Rationality

Prior to delving into past problems, texts, or interpretations, a genealogist should first interpret what their chosen referent and practice's contemporary 'rationality' is. Generally put, a rationality is the everyday background or discursive frame through which thought filters, elaborates, accrues, and organizes knowledge. It is the historically specific style of thought that orients the way(s) in which reality is rendered thinkable and debatable for subjects in a given time and place (Miller and Rose 2008, 16). A rationality determines the historical possibility of what surfaces in every practice:

> One is not assessing things in terms of an absolute against which they [practices] could be evaluated as constituting more or less perfect forms of rationality, but rather examining how forms of rationality inscribe themselves in practices or systems of practices, and what role they play within them, because it is true that 'practices' do not exist without a certain regime of rationality. (Foucault 2002a, 229)

Once a genealogist interprets the rationality undergirding their current problematized practice, they may then compare it with rationalities of the past. Without this careful and detailed historical comparison, a genealogical critique is difficult, if not impossible. "[W]e are thinking beings", Foucault claimed, and so we act "on the specific ground of

a historical rationality. It is this rationality, and the life and death game that takes place in it, that I'd like to investigate from a historical point of view" (2002b, 405).

This is also what makes a genealogy a nominalist analytic capable of escaping the fallacies of presentism/finalism affecting IR's dominant historical narratives. Prior to a genealogical analysis taking place, it is impossible to anticipate from one's present standpoint where, how, and when, past rationalities will overlap, transform, and emerge into what we have mistakenly assumed is the natural or immutable referent we are so familiar with, and have thus problematised.

As noted in chapter 1, a widespread and subtle practice engaged in by scholars when conceptualising global climate change and the Anthropocene is that of powerlessness and failure. Evinced through the warnings of the inexorable failure of COP21, and ubiquitous when considering the failed COP19 conference in Copenhagen, Denmark, in 2009 (see Harris 2013), practices and discourses highlighting the presence or spectre of failure seem endemic to concepts of climate change and the Anthropocene. Even textbooks, for instance, now commonly begin by asking: "How should governments respond to the apparent failure of the 2009 Copenhagen Conference on climate change?" (Falkner et al. 2011, 202; Harris 2013), whilst climate scientists lament how attempts to curb this failure fosters ever more increasing "failure, rancor, and disillusionment. . . Few are holding their breath [for solutions]" (Hulme 2014, viii). Chapter 5 thus traces how a 'rationality of powerlessness' emerged when the concept of a 'climate' became global, by being *conjoined to* these notions of failure. In other words, the style of thought scaffolding the 'global climate' was always one that was broken, powerless, failing. This rationality is illustrated in international conferences in the 1970s and 80s, as the global climate become an object of concern and (global) governance.

From these overlapping discourses of globality – nuclear problematiques, GCMs, and a rationality of powerlessness and failure – a new form of thought then crystalises. The precise nature and form of this 'globality' is one that is identified in the next stage of this genealogical project in chapter 6: emergence.

(d) Emergence

As a genealogist documents, traces, and interprets the surface of past practices and rationalities, they will at times appear obscure or even irrelevant to one's presentist/finalist perspective. Why? Lost or foreign styles of thought will naturally appear as alien or banal when considered from one's present(ist) vantage point. Yet, this step demands patience from the genealogist, for whilst they are parsing through these seemingly lost or irrelevant rationalities, an important and transformative 'event' should occur at an unanticipated or unexpected moment. This event is the unexpected 'emergence' of one's own contemporary referents, concepts, or rationalities into being.

As Foucault stressed, 'emergence' is not an origin, which implies a primordially pure and truthful universality that "assumes the existence of immobile forms that precede the external world of accident and succession" (1991, 78). Rather, detecting the emergence of one's problematized concepts is an invitation to examine this accidental overlap and congelation of practices once thought to be unrelated or disparate. Interpreting their underlying rationality anew, it should then be embraced as an opportunity for the analyst to examine the complex circumstances surrounding this event. 'What forgotten problem of thought created the conceptual space that this rationality and referent filled? What combinations of concepts fused together into these new forms? If it was once emergent and new, what contributed to its becoming ossified and naturalized until appearing as normal, universal, or unquestionable in the present?' (For example, see Walters 2012, 132; Foucault 1991; Foucault 2000c, 201; Koopman 2013, 15). By interpreting and uncovering the unexpected historical emergence of the problematised referent and its rationality, the genealogist thereby gains a new understanding of how their present subjectivity and perspectival standpoint came into being and became thinkable. Hence, a history of the present, rather than one of the past.

As noted in chapter 1, today's dominant rationality relies heavily upon concepts of humanity and globality as being part of an inexorable "geostory that integrates, shapes

and counterweights not only human history but also the geo-human future: the Anthropocene epoch" (Edwards 2016, 193). Indeed, the emergence of the rationality underpinning this supposed epoch will be discussed in chapter 6, which argues that its globality is evinced through what this thesis identifies as a global biopolitics of carbon, consisting of a technological subjectivism defined as *relationality*.

In following these steps, an enhanced capacity for a new analysis of global climate change and the Anthropocene, and critiques and interpretations of the concepts sustaining them, is facilitated. This analysis and interpretation is what is taken up in chapters 7 and 8 of this thesis, in which the temporality, security, and notions of 'entanglement' that are currently in vogue in discourses of the Anthropocene, are (re)considered.

Genealogy and (Global) Governmentality

This thesis answers the call of many IR and Foucauldian scholars to combine genealogical analytics with governmentality (Dean 2010; Biebricher 2008; Saar 2002; Andersson 2013; Walters 2012). Indeed, "Foucault is quite explicit about the fact that his investigation of governmentality was to be conducted in conjunction with the methods that he had previously grouped under the rubric of genealogy" (Walters 2012, 113). Why? Like genealogy, governmentality aims to analyze subjectivity in ways that avoid the fallacies of presentism/finalism, or the application of concepts to referents from the 'top-down'.

A top-down application of governmentality mutes the subtle shifts in knowledge, empirical investigation of practices, and discovery of random and contingent overlaps and encounters, that a genealogy offers to those willing to brave dusty archival pages. Approaching any topic solely through the lens of governmentality, therefore, risks this applicationism through an "aerial" view that runs dangerously close to "refashioned grand theory" (Walters 2012, 114; May 2005). So, whilst genealogy provides a nominalist interpretation of how concepts emerged contingently and unexpectedly to

shape the way we think, governmentality embraces the shock of this denaturalisation to elaborate the systematic and technical nuances *of* the operation of these concepts within conduct (Neumann and Sending 2010, 10). In other words, a genealogy provides the history of our present, whilst governmentality analyses the *conduct of* this present. Its forms of visibility, or ways of seeing and perceiving; its distinctive ways of thinking, questioning, and producing truth; its specific ways of acting, intervening, and directing, through forms of knowledge and technology; and its ways of forming ourselves as subjects through technologies and knowledge practices (Dean 2010, 33).

For IR, a discipline generally wedded to theorising statist units, systems, and structures within decentralized or anarchical realms (Hollis and Smith 1990), combining genealogy and governmentality offers new analytical insights into politics and human behavior. It exposes the "productive and micropolitical dimensions of power over [IR's] traditional concerns with instrumental control or structural domination; discursive and practical dimensions of politics over concerns with political agents and structures; and epistemic and technical dimensions of governance concerns with authority and institutions" (Jaeger 2013, 26). It can analyze anew how the subjectivity of a human agent is delimited, channeled, and regulated through tacit actions and technologies commonly overlooked through statist lenses.

This takes us to the focus of this thesis: the axiomatic globality of climate change and the Anthropocene. Can governmentality go as 'global?' as these concepts?[1] Indeed, a burgeoning new global governmentality literature is emerging in IR (for a small sample, see Neumann and Sending 2010; Joseph 2012; Corry 2013; Death 2010; Jaeger 2010; Merlingen 2010; de Larrinaga and Doucet 2010). It seeks to "problematize the constitution and governance of spaces above, beyond, between and across states", thereby conceiving of global governance and globality in a new way: as a constellation

[1] It should be noted that the term 'global' is itself contested, but this debate will not be explored here due to space constraints. This thesis defines the concept or notion of 'the global' as a physical, ontological, and epistemic referent "that can directly affect humankind as a whole, both as object and subject (or as target and actor), in a nearly equal and potentially lethal manner" (Cerutti 2007, 2). For an excellent overview of debates and meanings surrounding 'the global', see the edited volume *Framing the Global* (Kahn 2014).

of (liberal) govern-mentalities, rationalities, or patterns of thought, that are now "becoming detectable at the global level . . . reconfigur[ing] the relations between states and other actors" (Neumann and Sending 2010, 16). However, some argue that this "scaling up" of governmentality to a global scale is less than an "interrogation of liberalism than a prop to reworked liberal accounts of the international arena" (Selby 2007, 325). This has resulted in what Vrasti (2013, 50) has called a "global governmentality debate".[1]

The global governmentality debate is split into two camps: one supporting it as an analytic of international and global processes, and one rejecting its possibility by restricting it to the socioeconomic conditions within nation-states (for a fuller treatment, see Hamilton 2014). It is worthwhile to review the basic arguments of both sides in order to contextualise global governmentality in IR today, and to see how this thesis moves beyond this debate.

On the one hand, opponents of global governmentality typically argue that: (1) There exist essential and unbridgeable methodological, ontological, and epistemological differences between domestic and inter-state governance, and a truly 'global' (neo)liberal rationality of governance. One cannot simply scale Foucauldian templates for micro-levels upwards to the macro-level of the state system (Selby 2007; Joseph 2013). (2) Global governmentality ignores the uneven distribution of (neo)liberalism and capital accumulation across states, sublimating the importance of local political conflicts by tacitly presupposing the ontological existence of a 'global' realm of politics as an apologia for IR's academic literature and analysis (Joseph 2010; 2013; Chandler 2009; 2010). (3) 'Global' governmentality ignores Foucault's own assertions that governmentality, as an analytic, be confined solely to problematiques of the state, and of liberal government (Selby 2007; Joseph 2010; 2013).

[1] For the most heated exchanges in this global governmentality debate, see the dialogue established between Kiersey (2008); Chandler (2009); Kiersey (2009); Rosenow (2009); Chandler (2010); Kiersey et al. (2010); and Joseph (2010).

On the other hand, advocates of global governmentality analytics respond that: (1) The historically unique and unprecedented emergence of globalised state relations can indeed buttress and describe newly-emerging global governmentalities, because they operate as "universal, but not truly global" rationalities (Vrasti 2013). A state's economic performance or structure may not sufficiently reflect the level that neoliberal economic *rationalities* have permeated and shaped the subjectivities within its populations, i.e. into enterprising or entrepreneurial individuals. (2) That governmentality is not manifested solely by, nor within, preordained discursive spatial demarcations, such as towns, cities, or states. Instead, it emerges through multifarious types of practices, occurring anywhere between an assortment of types of agents at various levels of self, family, group, institution, state, economy, etc. Where there are competing knowledges, actions, and conducts, in other words, there is a fluid and implicit form of government fueling the impetus for, and possibilities of, inter-action (Kiersey et al. 2010). (3) Neoliberal rationalities are not limited to the state, as evinced by their promotion amongst international and non-governmental organizations that generate and evince new problematics of liberal governance across the globe, thickening the international with economically and politically liberal norms and rationalities (Neumann and Sending 2007; 2010). The diffusion of norms considered 'liberal', such as human rights, democratic political governance, and free-market economics, is indicative of this liberalisation of the international into the global.

Finally, proponents of global governmentality also argue that power, existing only as a *relation* conducting the knowledge and thought between actors, is not limited to the *successful* operationalization or implementation of state-led initiatives. It can be equally as effective in *failed* attempts at liberal governance (Methmann 2014), democratic governance (Cruikshank 1996), or as self-governance and self-formation (Dean 1995). In other words, a liberal initiative does not always have to 'work' for it to change and determine the implicit boundaries conducting how people think and act. We remain governed by our failures just as much, if not more so, than our successes.

However, a problem that arises is that both sides of this global governmentality debate remain fixated or dependent upon *liberalism* as the foundation for both 'the social' and governmentality itself. It is taken for granted that, as Barry et al. (1996, 8) declare, "it was only with the emergence of liberalism that it was possible for a domain of 'society' to emerge", and hence that "liberal political reason is the historical condition of the very object of their [social science] disciplines – 'society'" (1996, 9). This implies that there is no governmentality without liberalism as a medium for analysing social conduct (hence, the critiques of Joseph 2010, 2013). What this thesis argues, however, is that the opposite is in fact the case: liberalism arose only after the application of scientific processes to a bounded polity (i.e. the state) were made; society and liberalism only then emerged as tangible objects *from* these calculations, rather than vice-versa.

In other words, and as will be argued below, governmentality is ultimately determined not by liberalism, nor by society, but by the application of scientific practices and processes to forms of life within a bounded space. This implies that a 'global' governmentality depends not upon the reach of liberal norms or capital, nor even upon states or the international system, but upon the type and form of scientific processes and procedures bringing life and the human subject into being in certain ways.

It is thus to the forgotten underpinning of governmentality, as first argued by Foucault – *Nature and scientific processes* – that this chapter turns.

The Emergence of Governmentality: Nature, Science, and Calculating Processes

The previous section highlighted the temptation of what has been called the "applicationism" of governmentality in IR (Walters 2012): "that is, treating governmentality as a fixed set of concepts and tools that one simply applies to empirical projects, whatever the topic." In this light, neither side of the global governmentality debate questioned the *liberal* roots of governmentality, instead applying it to economic, statist, or global problems.

This thesis rejects this applicationism by stepping back to reconsider the conceptual foundation of governmentality itself. It acknowledges IR's penchant for liberal applicationism in its global governmentality debate, as well as the diverse scholarship on forms of liberal carbon governmentality that either accept or ignore this danger (see chapter 6). Yet this thesis is able to circumvent these problems by developing a form of governmentality that exists and functions separately from both liberalism, and from the state, whilst not being hostile, exclusive, nor antithetical to either. This new conceptual foundation for global governmentality analytics can be found not by debating about its future applications, but by returning to the philosophical foundations and texts from which the analytic emerged.

When considering global (environmental) crises, despite today's debates over complex carbon markets, carbon accounting, or biopolitical and liberal climate governmentalities, we must remember that the essence or core of Foucault's biopolitics – *and* governmentality – was not liberalism or society. It was Nature, and how "the sciences of nature, and physics in particular" brought both Nature and political dynamics and forces into being (Foucault 2007, 296). Nature was the "other face" of governmentality, "something that runs under, through, and in the exercise of governmentality. It is, if you like, its indispensible hypodermis" (Foucault 2008, 16).

Why Nature, and not liberalism or society? According to Foucault, the development of (liberal) political economy emerged only *after* the natural sciences isolated Laws of Nature based upon physical cycles and processes. Applied to human beings, "if there is a nature specific to the objects and operations of governmentality, then the consequence of this is that governmental practice can only do what it has to do by respecting this nature" (Foucault 2008, 16). Take the liberal market, for example. Only once the market's "natural" cycles and mechanisms were first identified in the 18th century by the physiocrats, by applying scientific conceptions and processes used to study Nature *to* a flux of bodies within a polity, could new truths then emerge into discursive circulation: the concept of 'population' as a new object of investigation with its own movements and laws, for example, came into being. Once this statistical object emerged, it could be re-

considered or redefined as economic, as social, etc. Contrary to its liberal application today, therefore, governmentality was first drawn not upon the canvas of society or liberalism, but upon Nature and processes detected by scientific naturalism. "[I]f we take them up at their origin, you can see that what characterizes this new art of government I have spoken about [governmentality] would be much more a naturalism than liberalism" (Foucault 2008, 61).

In this regard, Foucault notes how the politics and philosophy of Kant's *Perpetual Peace* echoes the background philosophico-scientific rationalities in vogue at this time, analogising politics from Nature's processes. "Nature intended the entire world, the whole of its surface, to be given over to the economic activity of production and exchange", prescribing even "juridical obligations for man, but which nature has in a way dictated to him secretly, which she has, as it were, marked out in the very arrangement of things, of geography, the climate, and so on" (Foucault 2008, 57). Natural science was the analytical bedrock here. Likewise, society itself emerged from discovering Nature's secrets through calculative investigations. It was not a self-evident statistical agglomeration resulting immediately from market calculations or liberal political economics, but arose only when scientific cycles and rhythms previously applied to biological life processes – the Laws of Nature – were developed alongside the state. "It is society as a naturalness specific to man's life in common . . . as a domain, a field of objects, as a possible domain of analysis, knowledge and intervention" that emerged from scientific processes as an object of study and intervention, claimed Foucault (2007, 349). "We are dealing with processes that can be known by methods of the same type as any scientific knowledge", shared and assumed amongst scientists and economists alike as their "scientific rationality" (2007, 350). Again, this highlights the importance of the primary aim of this thesis: questioning how scientific processes are applied to Nature today, and what (unexpected) rationalities, patterns, or objects, might emerge from them when considering the axiomatic globality of climate change and the Anthropocene.

Prior to Foucault, Arendt had also highlighted how the biological cycles of labour, when transposed from the privacy of the household (*economia*) upwards to the state level, created a nation-wide form of 'housekeeping' grounded upon statistical calculations (1998). For Arendt, like Foucault, this fostered the rise of the social realm and the liberal economy by making the private life processes of the *economia* into the public realm of social and political economy (see chapter 6). The point here is that, in order for 'governmentality' to emerge, scientific rationalities that were typically applied to Nature were transposed to human beings within a polity. Science *undergirded* both society and liberalism, and not the other way around.

However, dominant social and scientific rationalities shifted when the natural sciences re-conceptualized Nature less in terms of natural flows and cycles, and more as a machine capable of being constructed artificially. Here, Foucault describes a general transition away from the biopolitical governmentality that first isolated 'natural' economic processes of flow and exchange within the police state, to something new. Contrary to the physiocrat's, Kant's, and Smith's use of Nature, in the 20th century German ordoliberals expunged this "naïve naturalism" and its claims to a "pre-existing nature, to a natural given that [the state and society] brings with it" (Foucault 2008, 120). At this point, government was, apparently, no longer predicated on obeying Nature's cycles but on "making" and securing the state artificially by establishing forms of economic freedom and markets that brought the state into being, *post hoc* (Foucault 2008, 87, 102). "Can the market really have the power of formalization for both the state and society? This is the important, crucial problem of present-day liberalism", notes Foucault, "and to that extent it represents an absolutely important mutation with regard to traditional liberal projects" (2008, 117). Here, for Foucault, governing a society becomes explicitly severed from understanding Nature's cycles and processes. Dynamics of enterprise, competition and the *homo economicus* as consumer, become strategies through which governments intervene in, and regulate, society. Indeed, IR is now familiar with this as a market rationality and legal order that brings the state into being under conditions of liberal, and eventually, advanced (neo)liberal government

(Foucault, 2008, 145-146). It remains the foundation of both sides of the global governmentality debate, examined above.

This brings us to one of the philosophical arguments of this thesis. If Foucault (2008, 22) is correct in asserting that "…only when we know what this governmental regime called liberalism was, will we be able to grasp what biopolitics is", and if liberalism and 'the social' *was* the result of a crystallization of the "sciences of Nature" applied to politics and life, then there is no reason that this implicit link between science, Nature, and biopolitical and governmental rationalities, does not exist today in some undetected form.

Indeed, if governmentality is a *nominalist* analytic, we must assume that undetected scientific rationalities might still be conducting our mentalities and rationalities in discourses of globality, climate change, and the Anthropocene, in ways still unknown to us. Rather than mute governmentality with a top-down liberal analytic, it thus behoves us to pursue a genealogical inquiry into our present conduct, whilst keeping this connection between scientific rationality and subjectivity in mind. In other words, a 'global governmentality' may not be liberal, but *scientific*.

The theoretical and philosophical task of this thesis in the following chapters, therefore, is to problematise how modern sciences of GCMs and ESS have interacted with human beings and with the state to shape the concepts of climate change and the Anthropocene into the axiomatic concepts we conceive of today. If a tacit homogeneity once made "the dynamics of politics and the dynamics of physics […] more or less contemporaneous" (Foucault 2007, 296), then it is by analyzing the sciences and physics of the Anthropocene, and their making of Nature into an object now destined by humanity, that new biopolitical and governmental forms and possibilities can emerge.

In order to do so, this thesis expands upon an oversight or omission made by Foucault himself. Foucault was clear that the basic concept of governmentality emerged through the genealogy of the state and governmental reason that he was conducting throughout

his 1977-78 lecture series (2007, 354). Indeed, 'governmentality' emerged suddenly and unexpectedly on 01 February, 1978. At this point, Foucault laments that "Basically, if I had wanted to give the lectures I am giving this year a more exact title, I certainly would not have chosen 'security, territory, population.' What I would really like to undertake is something that I would call a history of 'governmentality.'" (Foucault 2007, 108). This raises an important question: why is it that governmentality arose only at this point? What caused Foucault to suddenly develop the concept, and expand upon it throughout the rest of his 1977-78 lectures?

He began his 1977-78 lecture series by focusing on how biological components of the human species became politicised and naturalisd as "bio-power" in the West (2007, 1). Yet, he then moves quickly into discussing scientific understandings of "circulation" (2007, 16-19). What he struggled with, at this early point, was reconciling the mechanisms and apparatuses of security he eagerly sought, with his earlier notions of sovereign power (i.e. macro forms of juridical power over a territory) and with disciplinary power (i.e. micro forms of power, or the structuring of local bodily spaces into distributions of hierarchical and functional elements) (Foucault 2007, 20). Answering this question would respond to his critic's accusations that sovereign and disciplinary power were one-dimensional and unidirectional top-down inscriptions of violence and force, branded upon a dominated human body. Now, in 1977-78, Foucault sought to create space for a power encapsulating human agency and freedom within the social realm (McNay 1996, 85).

He thus ventures into the biology of Lamarck and the physics of "Newton and the Newtonians" so as to "account for action at a distance of one body on another", acting through what he called the space of the milieu (2007, 20). The point here is that the milieu – grounded on Newton's classical model of physics, explicating the action at a distance of one body upon another – is a set of natural and artificial givens bearing on all subjects, "a field of intervention in which . . . one tries to affect, precisely, a population" (2007, 21). Through it, population appears as an object that can be explored through the circulation and scarcity of grain, rather than the dictates of sovereign or

disciplinary power (see the 18 January, 1978 lecture). What he concludes as "fundamental" from this is not sovereignty nor discipline, but "A physics of power, or a power thought of as physical action in the element of nature" that can only be carried out through the "freedom of circulation" of a *new* technology of power (2007, 49). But what is this new technology of power?

In his next lecture (25 January, 1978), he examines how the quantitative analyses of smallpox affects the milieu, realising that calculation is what circumscribes or gives bounds to the population as existing in a place, space, and time (2007, 60). He concludes from this that "the mechanism of security does not function on the axis of the sovereign-subject relationship . . . They are connected to what the physiocrats called physical processes, which could be called natural processes" (2007, 65). Based upon the application of biological and physical processes and concepts to the state, "the central point of all this" becomes a form governmental action oriented around the specific processes of a calculated population (2007, 66). With the physiocrats and eighteenth century economists, the population becomes "considered as a set of processes to be managed at the level and on the basis of what is natural in these processes" (2007, 70). To govern, one must now respect and deploy "reflected procedures of government within this nature, with the help of it, and with regard to it", especially as the population becomes known biologically as a human species, rather than as "mankind" (2007, 75).

It is at this point, through the application of Newtonian physics and scientific processes to the human species as the new political medium or 'object' of population, that "government" emerges as the new technology of power sought by Foucault (2007, 76). "Hence the theme of man, and the 'human sciences' that analyze him as a living being, working individual, and speaking subject, should be understood on the basis of the emergence of population" (2007, 79). What he identified as an "era of governmentality discovered in the eighteenth century" (2007, 109), therefore, emerged genealogically by interpreting how scientific processes of Newtonian physics, the milieu, circulation, and quantification, circumscribed life that was bounded within a territory. Indeed, Foucault

remained adamant that scientific naturalism and physics remained "the permanent correlative" of biopolitics and governmentality going forth (2008, 16).

Now, a mistake of Foucault's (he was still human, after all) was later to use this technology of governmentality retroactively. He inserts it backwards in time, to cover his first series of lectures, as if the concept had always existed, and could be traced on a continuous or linear timescale outside of his own genealogical rendering. For instance, in his last lecture of 05 April, 1978, he now claims that governmentality was *always* a part of the milieu, discourses of circulation, etc.: "A new governmentality is born with the *économistes* more than a century after the appearance of that other governmentality in the seventeenth century. The government of the *politiques* gives us police, and the government of the *économistes* introduce us, I think, to some of the fundamental lines of modern and contemporary governmentality" (Foucault 2007, 348).[1] What this implies, however, is that Foucault succumbs to a presentism/finalism of his own. He makes his notion of governmentality – one that emerged through the specific notions of Newtonian physics and circulation – into an atemporal or ideal theory or concept, that can be used at any time. So, rather than an analytic of a form of subjectivity that existed in one place or form, and not in others, it becomes a foundation for – as he uses it in 1978-79 – (neo)liberalism. This results his later 1978-79 lectures (see Foucault 2008) treating governmentality more as a top-down analytic of liberalism, than as the contingent historical technology that emerged genealogically, through practices and processes of science and physics being applied to life in a polity. In 1978-79, physics is paid some lip service, but ultimately stops being problematized and examined. In its place, artificial competition replaces the "naïve naturalism" of the market as a sort of natural given (Foucault 2008, 120). The population is still heavily invoked, but its conceptual foundation upon Newtonian physical processes is forgotten.

[1] This is certainly *not* to say that governmentality cannot be applied, as an analytic of power and subjectivity, to a variety of times, places, spaces, and relations of individuals (see Foucault 2007, 108-109). Rather, it is to say that in making this move during the context his 1977-78 lectures, Foucault omits how his genealogical project resulted in the emergence of this concept as a specific technology from specific scientific processes. The danger thus becomes generalising these specific processes, to other times, places, spaces, and relations of individuals, without the correlative genealogical investigation.

If governmentality is correlated permanently with science and physics, this would imply that changes in one indicate changes in the other. Indeed, preceding this inversion of scientific naturalism into an artificial liberalism, Foucault briefly highlighted a "type of rationality considered valid within the natural sciences. In short, what we can broadly call technology" (2008, 115). "Technicization of state management, of control of the economy" was connected with the rise of Nazism and state control of the market, and then to the state's refusal to govern the market through this technicization after World War II. Yet, the scientific rationalities underpinning this artificial 'rationality of technology' – was assumed by Foucault to function according to the calculative and statistical regimes that had emerged earlier, through naturalism. The problem here is that naturalism, Newtonian physics, and the milieu, were clearly outdated sciences at this point, especially with the rise of quantum mechanics (see chapter 8). Rather than a renewed genealogical ethos, the market, society, and technicization remain treated as an unproblematic and unexamined background context for later analyses of the artificiality of neoliberalism. Or, to put it another way, the permanent correlation between science, physics, and government, is broken here. Technology and physics becomes an *instrumental* part of liberalism, statistical normalization, artificial standardization, and individuation, rather than being problematized in-itself, or interpreted as to how it might correlate as a new technology of power. Thus, whether the permanent correlative between science, Nature, technology, and political practice, remained in new forms within this rationality of technology and its concomitant marketisation, was left unexplored.

What this omission implies is that today's biopolitical and governmentality analytics remain based on Foucault's interpretation of outdated sciences and technologies from the 16th to early-20th centuries (e.g. circulation, the milieu, force dynamics, and Newtonian physics). Concepts we take for granted in Foucauldian literature in IR and the social sciences – those that emerged from Foucault's 1977-78 foray into physical processes, such as population, society, and governmentality – thereby retain the underlying scientific rationalities derived from, and for, the bygone natural processes of the French physiocrats. In other words, although the software of biopolitics and

governmentality appears modern, it is actually its hardware (i.e. Newtonian physical processes and calculations of nature) that is antiquated. Specific views of Nature and science have since changed, but 'the population' remains as an object nonetheless. This is a curious discrepancy for a nominalist analytic stressing historical contingency. Yet, the underlying correlation between transformations in scientific rationality, technology, and political reason, may remain just as strong today. All that remains is for a genealogical analysis of these concepts and practices to be undertaken so as to escape presentism/finalism and applicationism. This is a gap in this literature that this thesis hopes to fill.

This thesis engages the physics and sciences that correlate Nature with politics today, the sciences of GCMs and the ESS. These underpin the globalities of both climate change and the Anthropocene. In so doing, it reveals a new form of global governmentality "which is, as it were, tête-à-tête with the art of government" in a new relationship of "knowledge and power, science and decision" (Foucault 2007, 351). Indeed, despite the global governmentality debate being deadlocked in its contestations over liberal rationalities and their scope, "nations clash over scraps from the economic pie – but at the planetary spatial scale, the atmosphere and oceans circulate unrestricted" (Edwards 2016, 190). It is precisely these processes of planetary circulation – i.e. atmospheric and oceanic processes, and their concomitant technicization into the globalities we take for granted – that will be explored in the following chapters.

Prior to the genealogical investigation of these scientific processes, it is important to clarify the constitution of this "technicization" or "rationality of technology" itself; the one hinted at – but then omitted – by Foucault.

Technology, Rationality, Metaphysics: Bringing subjectivity into Being

If the philosophical basis of this thesis analyses how scientific processes and discourses of Nature correlate with politics, then climate change and the Anthropocene are excellent concepts to problematise. The existence, essence, and knowledge of both is

grounded not upon liberalism, capital, nor markets, but upon the technicisation of Nature itself: the calculation of global physical processes, i.e. computerised simulations of atmospheric and oceanic fluid dynamics (see Heavens 2013).

Although they are taken for granted as banal or 'natural' in common discourse and parlance, notions of a global climate and Anthropocene epoch are borne out of incredibly complex simulations and models. These models quantify and calculate the physical processes of the Earth's fluid dynamics, and make them cognizable or amenable to human comprehension. As Edwards (2010, xiv) succinctly phrases it: "*Everything we know about the world's climate—past, present, and future—we know through models*" (emphasis original). Indeed, our knowledge of the global climate and Anthropocene "would be impossible without the use of global climate models (GCMS) . . . [which] are powerful computer programs that use physical processes to replicate, as accurately as possible, the functioning of the global climate system." (Fenech et al. 2007, 133). As odd as it sounds, whenever we think of 'global climate change' or 'the Anthropocene', we are channeling and manifesting concepts derived and congealed from computerised data.

Generally put, all GCMs are based upon the physics of atmospheric fluid dynamics, which simulate planetary heat exchange and circulation throughout the atmosphere and oceans (models linking atmosphere-oceans may also be called AOGCMs). Although GCMs are discussed in chapters 3 and 4, it is important to highlight here their conceptual dependence upon simulations embracing modern physics. Generally, to make the global climate or Earth system *thinkable*, these models engage two steps: first, creating a "dynamical core" that simulates large-scale atmospheric movements through primitive equations of fluid motion, represented in numerical grids. Second, the "model physics" of planetary processes too complex to compute, emanating from molecular to atmospheric scales, must somehow be represented. This occurs through a "sub-grid-scale physics indirectly by means of parameters (mathematical functions and constants that capture the large-scale effects of smaller-scale processes without modeling them directly)." (Edwards 2010, 146). This is also called Parameterisation. So, following

Foucault, how is it best to theorise or analyse how the physics and processes detailed by these GCMs and their grids of 'parameterizations' are applied to politics and international relations today? How should we interpret the operation of the scientific rationality underpinning them?

It is here where the philosophies of Martin Heidegger and Hannah Arendt are able to fill the void or lacuna regarding technology and physics that was left by Foucault. Each goes beyond Foucault's limited account of technology by engaging not only processes of mathematisation and physics, but their underlying *meta*-physics. Indeed, echoing Foucault's discussion of historical regimes of truth, Heidegger (1977b, 115) writes that "Metaphysics grounds an age, in that through a specific interpretation of what is and through a specific comprehension of truth it gives to that age the basis upon which it is essentially formed." Since Foucault's problem was always "to see how men govern (themselves and others) by the production of truth . . . the establishment of domains in which the practice of true and false can be made" (2002a, 230), there is an obvious symmetry here concerning the historical fluctuation of thought and truth, and its concretisation in shared practices.

First, it must be stated that to explore the many overlaps and disagreements between the complex and substantial works of each of these thinkers would be well beyond the scope of this chapter, and even this project (for a small sample of such comparisons, see Villa 1996; Villa 2006; Milchman and Rosenberg 2003; Rayner 2007; Dreyfus 1989; Elden 2001; Nichols 2014; Iyer 2014; King and Stone 2007). Rather, since this chapter's aim is now to elaborate how genealogy and governmentality analytics can illuminate today's 'rationality of technology' left in the dark by Foucault, it focuses on a point where each of these thinkers overlaps: a point that Foucault (2005, 14) called the "Cartesian moment".

The Cartesian moment was an historical event and transformation in Western thought. It was at this moment that the West's understanding of the relationship between humanity, science, and physical nature, was problematized in unprecedented ways. Prior to it, in

the sixteenth century, it was commonplace knowledge that everything in nature testified to God's dominion over and through the "entire fabric of the world, natural or human, and [it was] apparent on every level of existence" (Toulmin 1990, 127; Arendt 2006). Indeed, at this time and through this cosmology, it was simply *known* that both politics and Nature were governed by the same laws: "What God is to nature, the King is to the State" (1990, 27), and so order, hierarchy, and nature, operated according to their place and rank in a great chain of Being. The human self was not yet a 'subject' certain of its own being as an 'I'. Instead, the human self was certain only of its own "obligation to Christian revelational truth and Church doctrine . . . in which the salvation of man's soul is made certain and guaranteed for him" (Heidegger 1977b, 148). At this point in time, the self was not yet a subjectivity.

The Cartesian moment occurred when these Aristotelian and medieval-scholastic understandings of Nature, politics, and the world – i.e. the self's certainty of its being and place within Christian doctrine and its certainty of salvation – transformed into our modern "cultural paradigm" through the philosophies (i.e. sciences) of Newton, but especially of Descartes (Dreyfus 2006, 354; Foucault, 2005; 2007). Rather than remaining part of a divine chain of Being, the adoption of Descartes's science fomented a metaphysical and cultural paradigm shift in which humanity became certain of *its own self* as its conceptual foundation. Or, as Heidegger (1977b, 148) writes, it was a "freeing of man [from Christian doctrine] to freedom as the self-determination that is certain of itself." It resulted in what we know today as the subject, or the capacity to think of our/selves in a world as a self, a subjectivity, or an 'I', represented or contrasted against external objects. From this Cartesian moment, a cosmology emerged in which subjectivity was in contrast to objectivity. Arendt (1998, 254) likewise highlighted this as the most important moment in modern philosophy: "an exclusive concern with the self, as distinguished from the soul or person or man in general, an attempt to reduce all experiences, with the world as well as with other human beings, to experiences between man and himself."

And thus in this Cartesian moment, we see the problem of 'government' breaking out suddenly in the "sixteenth century with respect to many different problems at the same time and in completely different aspects" (Foucault 2007, 88). The emergence of subjectivity transformed politics. Yet, why would this 'subjectivity' be connected to political transformations in government and states? This concerns how the self as subjectivity or 'I' relates to truth as objectivity: through measurements and calculations, such as population arithmetic. Suddenly, after the Cartesian moment, subjective truth became a form of knowledge representing an accurate picture of the external object-ive nature of the world, back to oneself, or 'I' (Foucault 2005; Heidegger 1977a; 1977b). "The Cartesian approach", writes Foucault (2005, 14), "refers to knowledge of the self, as a form of consciousness . . . the modern age of the history of truth begins when knowledge itself and knowledge alone gives access to truth". Truth, as a self-certain knowledge that the *cogito* of the subject – the I – possesses about external objects (2005, 17). Finally, Foucault adds that:

> What's more, by putting the self-evidence of the subject's own existence at the very source of access to being, this knowledge of oneself (. . . in the form of the impossibility of doubting my existence as subject) made the "know yourself" into a fundamental means of access to truth. (2005, 14)

Therefore, the Western cultural paradigm became grounded on subjectivity and the 'I' as a self-certainty, deriving truth about objective Nature through calculative or measurable scientific practices.

What is crucial about the Cartesian moment for this thesis is twofold: first, it is the moment when sciences such as population arithmetic (i.e. statistics) are first able to be applied to the state, thereby detecting processes that led to the emergence of society and governmentality (Foucault 2007). Indeed, this transformation comprised "an epoch-making . . . social epistemology" (McCormick 2014, 240), made possible through subjectivity as a new foundation or grounds for being. Second, not only does Heidegger share Foucault's emphasis on this moment as a cultural paradigm shift, but he identifies

it as being *technological* at its conceptual root. In other words, underpinning this Cartesian moment, is a metaphysics of technology that suits the 'rationality of technology' omitted by Foucault.

How is the application of scientific processes to life, technological? For Heidegger (1977a, 22), the Cartesian "modern physical theory of nature prepares the way first not simply for technology but for the essence of modern technology." This essence of technology is actually nothing technological, if by 'technological' we are referring to the explicit, commonplace, anthropocentric understanding of machine or digital technology that we have taken for granted today. Instruments or networks comprised of computers, automobiles, rockets, mobile phones, the internet, etc., that humans use as means to ends. This is indeed the "material or physical" rendering of technology that is usually embraced in IR (Skolnikoff 1993), splitting into camps of technological determinists (i.e. technology is autonomous), or social constructivists (i.e. technology depends upon intersubjective meaning). Technology is then discussed in an abstract way, or it is used as an explanatory variable in a vague fashion (Herrera 2007). However, even in IR, "No technology is truly autonomous; they are all partly social. Yet neither are the political meanings of technologies infinitely malleable" (Herrerra 2007, 575). Technology for IR depends on what one makes of it.

Heidegger successfully avoids this conundrum by defining the essence of technology as a particular metaphysical rationality, or way of revealing beings and referents as being 'true' for humans in a group, or within their shared cultural paradigm. This technological metaphysics is what grounds an age (1977b). Its essence is what Heidegger called the 'enframing' (*Ge-Stell*) of Being,[1] the way that a subjectivity implicitly challenges every object forth into cognition for itself, as a representation to be measured or calculated. Enframing thus explains why modern technology must always increasingly "employ exact physical science" (1977a, 23), such as the application of

[1] Enframing denotes "Modern science's way of representing [that] pursues and entraps nature as a calculable coherence of forces", or "the gathering together of that setting-upon which sets upon man, i.e., challenges him forth to reveal the real in the mode of ordering", regulating, securing, and calculating, called "standing reserve" (*Bestand*) (1977a, 17. Also, for an application in IR see Alt 2015).

processes to relations of bodies (Foucault 2007, 349). With self-certainty grounding subjectivity, it must challenge-forth, set upon, and thus order reality as objectivity in order to always be sure of itself.

Hence, Foucault's rationality of technology is neither material nor social, but is a metaphysical way that subjectivity delimits being(s) and reality for the Cartesian I: as an endless collection of external objects, the relations between which may be quantified and calculated *ad infinitum*. Indeed, from the Cartesian moment onwards, it is "Circumscribing [enframing, that] gives bounds to the thing. With the bounds the thing does not stop; rather from out of them it begins to be what, after production, it will be" (Heidegger 1977a, 8). The transformations in government achieved through the sciences, processes, and statistics that circumscribed the bounds of society and population in the emergent state – what we know as governmentality – are, therefore, technological. And through understanding this (metaphysical) rationality of technology, the question of whether enframing *governs* governmentality, becomes an interesting consideration of this project going forth through each chapter.

Although enframing and governmentality have been touched upon in IR (see Alt 2015; Michels, 2012; Joronen 2008; 2013), in many ways these accounts resemble that of the liberal applicationism of governmentality noted above. In IR, enframing is not used as a conceptual tool for detecting new modes of being or thought, but it is declared in a top-down fashion as an always already omnipresent and nefarious force, sweeping away the innate 'being' of whatever referent scholars choose to apply it to. For example, in arguing that enframing is the metaphysical essence of a global neoliberal governmentality, Joronen (2013, 357, emphasis original) asserts that "neoliberalisation is a process of *ontological violence*, which does not merely govern the conduct of individuals . . . but also enframes all entities for the use of market forces", and thus "represents everything that is nihilist in a contemporary world-economy:" planetary homelessness, aimlessness, mischief, and "the constant devaluation of nature and human existence as mere stocks of profits" (2013, 360). In other words, this structural or top-down applicationism of enframing and governmentality makes them akin to an old-

fashioned Marxist ideology critique. It thus appears that any topic involving quantification and a human subject is automatically predestined as a "violence against Being" itself. Like governmentality, when enframing is restricted to applications already predetermined as negative or harmful, the opportunity to detect new relationships between technology and human subjectivity is likewise bracketed.

The final section of this chapter elaborates how this project avoids this applicationalism, by using the philosophy of Arendt to mediate between Heidegger and Foucault's understanding of the social.

Technology, Subjectivity, and the Human Condition

In the few instances where enframing and governmentality are used together, they are indeed conflated with domination or neoliberalism. This arises because there remains a theoretical gap between these two concepts and thinkers. It exists in what some scholars have previously identified as Heidegger's account of Being and metaphysics, and Foucault's account of power and subject-formation (Dreyfus 1989). Whilst Heidegger focuses on the epochal and technological emergence of things, Foucault gravitates towards the ways subjects are formed *by* these technological things (Elden 2001, 15). This creates the question of how each angle of their shared technological rationality actually intersects in a single social and political realm, where speech, debate, action, revolution, and violence, actually occurs. It is to mediate this political gap, therefore, that this thesis embraces the work of one of the foremost thinkers on the social and the human condition: Hannah Arendt.

Whilst Arendt's view of technology and Cartesian subjectivism provide a dialogue with (and at times, a critique of) Heidegger's technological metaphysics (Villa 1996; Yaqoob 2014, 7), her grasp of social conditioning and the effect of scientific rationalities upon the human condition – as well as foundational insights into the nature of power and biopower – overlap with that of Foucault (see Dolan 2005; Owens 2006, 157). As the Cartesian moment transformed human consciousness into the 'I' of subjectivity, Arendt

also notes how an "Earth alienation supplanted Aristotelianism with an understanding of nature as a range of universal processes located in infinite and homogenous space" (Yaqoob 2014, 13). Arendt likewise concurs that "the social" or society "is a relatively new phenomenon whose origin coincided with the emergence of the modern age and which found its political form in the nation-state" (1998, 28). Prior to Foucault's discussion of biopolitics, Arendt was already theorising how the "emergence of society" and "the rise of the social" transformed what was once private matters within the household – the *economia* – into matters of public concern for all: "the bodies of peoples and political communities [became translated] into the image of a family whose everyday affairs have to be taken care of by a giant, nation-wide administration of housekeeping" (1998, 28). A pre-Foucauldian notion of biopolitics.

Unlike monarchy or sovereignty (but akin to governmentality), for Arendt, society operates according to "a kind of no-man rule" which "expects from each of its members a certain kind of behavior, imposing innumerable and various rules, all of which tend to 'normalize' its members, to make them behave, to exclude spontaneous action or outstanding achievement" (1998, 40). Echoing Heidegger and anticipating the work of Foucault, she argues that science and politics share a metaphysical foundation akin to technological enframing. Indeed, "through society it is the life process itself which . . . has been channeled into the public realm" (1998, 45) sublimating unpredictable political action and the sovereign and hierarchical power of God and King, for the stable and mechanistic *processes* best captured by "statistics, that is, the mathematical treatment of reality, [which] was unknown prior to the modern age" (1998, 43). Arendt is able, therefore, to link the technological metaphysics underlying the Cartesian moment to the modern sociopolitical constitution of subjectivity and government in our present moment. What results – and as will be argued in chapters 4, 6,7, and 8, – is a reduction of all human and subjective experience of Nature, world, and self, to the exclusive concern with (human) life as always, and everywhere, reflecting and seeing itself (Arendt 1998, 254; Heidegger 1977a, 27; Foucault 2005). If "man is the measure of all things", then man becomes the only being *outside* of this technological metaphysical means-end relationship; meaning that everything, including Nature, society, politics, and

the state, must become reflected back to himself as a means to humanity's own end (1998, 158). It should be stressed that, although Heidegger and Foucault are used predominantly throughout this thesis, Arendt's thought is no less important, nor less powerful or compelling. Readers of this thesis should carry her identification of calculation with subjectivism throughout each chapter.

A brief example concerning globality in IR points to the benefit of using these three thinkers in tandem in this thesis. At the outset of *The Politics of Globality*, van Munster and Sylvest quote Heidegger in their epitaph. It is a quote based on the metaphysics of enframing (although van Munster and Sylvest do not elaborate on this). The epitaph reads: "The fundamental event of modernity is the conquest of the world as picture" (Heidegger, as quoted in van Munster and Sylvest, 2016, 1. Also, see Burke et al. 2016, 504, who uses this quote in a similar way). However, in the context of globality as IR conceives it (i.e. spatially and politically), this is a misquote. Heidegger's 'world picture' is neither a *spatial nor geographical* world picture, as van Munster and Sylvest assume. Nor is it referring to an emergent 'globality', as the authors suggest, when humans first "set eye on the Earth" during NASA's Apollo missions. Heidegger's 'world picture' does not actually refer to a picture of the world.

Instead, Heidegger's world picture refers to the way enframing represents being(s) metaphysically and subjectively: as representational objects, to be calculated by an 'I', or as a subject always measuring itself in-relation to things *as* objects. A 'world picture' could therefore be on an atomic level, entirely local to and contained within an individual subjectivity. Or, it could be global, but only channeled through the representation of a subjectivised 'I', or subjectivity. It involves only a subject 'picturing' any external object in its 'world', re-cognizing or picturing it back to itself as a re-presentation. The world picture is not the Earth or the planet, as IR has framed it thus far.

Yet it is not Foucault, but the work of Arendt that is best able to provide a link from this Heideggerian metaphysics to the conduct of conduct. For instance, she argues that this

form of world picture ushers in "the end of the common world" because it is seen from only one perspective (Arendt 1998, 51). If politics depends upon multiple perspectives sharing in and debating about their world – "To live together in the world means essentially that a world of things is between those who have it in common, as a table is located between those who sit around it" (1998, 52) – then Heidegger's planetary imperialism of subjective enframing is linked to how technological power "subjugates and makes subject to" (Foucault 2002a, 331), and how governmentality "is both an individualizing and totalizing form of power" (Foucault 2002a, 331). Connecting the two is Arendt's notion of the human social and political world, for "the world, like every in-between, relates and separates men at the same time" (1998, 52). As will be argued in chapter 8 when this thesis examines IR's use of quantum entanglement, Arendt is thus able to capture how the sharing of this world picture 'subjugates and makes subject to' by reflecting human perception backwards upon itself, measuring itself. It is each mind holding itself within its own picture. This notion of 'world' and the way that subjectivity is actively conditioned through what Arendt calls the *vita activa* will be elaborated in chapter 4.

It should also be noted that Arendt's philosophy supports Heidegger's and Foucault's in ways that overcome the shortcomings of the recent new materialist bent of critical IR scholarship (see chapter 1). Rather than ontologising and reifying materiality to assert that entanglement overcomes modernist subject/object binaries, Arendt stresses how any consideration of the human subject also demands a researcher consider the *intangible* aspects of the human condition. Although language, speech, and memory are not material, "for all [their] intangibility, this in-between is no less real than the world of things we visibly have in common. We call this reality the 'web' of human relationships, indicating by the metaphor its somewhat intangible quality" (Arendt 1998, 183). The position of this thesis, and its use of Foucauldian, Heideggarian, and Arendtian philosophy, is indeed that the intangibility of human thought and its historical transformations are essential to understanding today's concepts of climatic globality. Just like Foucault's assertions that 'power' has no materiality because it is a subjective relation between actors, so Arendt concurs that power "is to an astonishing degree

independent of material factors, either of numbers or means" (Arendt 1998, 200). Language, speech, and memory emerge only through the interaction of plural human beings with one another, but their intangibility makes them no less important. Without their creation within the plural interactions that delimit a human social world through speech and its concomitant flux of power relations, there is no Earth, 'matter', or materiality to speak of at all: "Without being talked about by men and without housing them, the world would not be a human artifice but a heap of unrelated things to which each isolated individual was at liberty to add one more object." Going forth, each chapter thereby probes the historical conditions of thought that allow things and objects to come to 'matter' in the ways and aspects IR scholarship considers them today.

In sum, the goal of this chapter was to outline the philosophical combination of thinkers that fills the genealogical framework of this thesis going forth: how the worldlessness of Arendt, the planetary metaphysics of Heidegger, and the governmentality of Foucault, all coalesce around the historical constitution of modern human subjectivity as an aftershock of the Cartesian moment. What 'matters', therefore, is not simply materiality, but the manner in which thought itself is shaped in particular times and places, and through what practices. How these aftershocks now ripple through our social and political world in the concepts of climate change and the Anthropocene, therefore – are indeed well-suited for the genealogical inquiry that the next chapter initiates.

Conclusion

This chapter has argued that enframing and governmentality are complementary when seeking the 'rationality of technology' omitted by Foucault. Both share a dependence on practices as shaping (inter)subjectivity, and importantly, both share an historical relativism that grasps Foucault's genealogy as correlative with Heidegger's historical ontology. A Foucauldian genealogy, as a "critical ontology of ourselves", fits well with the "historical ontology" of Heidegger (Elden 1996, 2003). Although both Heidegger and Foucault understand 'truth' to be not universal but historically contingent, shaping the subject through collective practices that are unique to time, place, and world, there

still remains a gap between the two. Arendt's thought thereby acts as a necessary bridge between these two philosophers, connecting the former's technological metaphysics with the social and human conditions that conduct power and subjectivity for the latter.

Chapter 3 – Our Climate is Nuclear: Problematising the Climate[1]

> There is little evidence that any change in the structure of world order is likely to come about in the years ahead, unless it is provoked by a catastrophe of awesome proportion. But let us not be deceived. . . The first need is to awaken the consciousness of men and women everywhere to the causes of their distress.
>
> Richard Falk (1972, 3)

> Time is short. And survival is at stake.
>
> Federation of American [Atomic] Scientists (1946, 159)

Introduction

This chapter problematises the globality of anthropogenic climate change. It asks how climate change became known and commonly considered today, alongside nuclear war, as "the greatest threat human society has ever faced" (Mann 2009, 230). Indeed, despite climate change entering discourses of global governance and public consciousness only in the late 1980s (van Munster and Sylvest 2016), and despite the threat of a nuclear catastrophe actually increasing since the end of the Cold War (Mecklin 2015), today it is common to read that "only nuclear weapons and climate change deserve the name of global challenges" (Cerutti 2012, 314; 2009). Thus, how did climate change become such a prominent global problem so quickly? How did it emerge to become considered by publics today as the greatest threat to the world (Pew Research 2015)?

This chapter argues that climate change did not develop alongside nuclear war as a global problem, but instead, emerged directly *from* it. Indeed, from its conceptual

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formation in postwar GCM technologies tracing radioactive fallout, to the first global climatic change popularised through fears of a nuclear winter, at its conceptual root, *our climate is nuclear*.

To demonstrate how our contemporary problematique of climate change is nuclear in its formation and dissemination, this chapter provides a genealogical analysis of a unique textual archive: the *Bulletin of the Atomic Scientists*. Since the testing of the first atomic bomb detonation at the Trinity test site near Alamogordo, New Mexico, USA, on 16 July 1945, *Bulletin* has assessed "scientific advancements that involve both benefits and risks to humanity, with the goal of influencing public policy to protect our planet and all its inhabitants" (2016). Indeed, *Bulletin* and its famous 'Doomsday Clock' act as a "widely recognized visualization of the likelihood of a global catastrophe . . . dependent not on single events but rather on the perceived trend of 'human society'" (Vuori 2010, 256). Notably, with *Bulletin* incorporating "runaway climate change" alongside nuclear war in 2010 as "the two gravest threats to civilization" (Vuori 2010, 256), the transformation and development of climate change within the catastrophic trends of *Bulletin* thus offers the potential for a genealogical analysis of the climate's emergence as a global problem.

As argued in chapter two, the first step in a genealogical analysis is to problematise a referent. To problematise the global climate, however, is not to simply analyse it with a critical mindset, or to review the many histories of this concept. Therefore, this chapter does not ask the obvious question (from today's perspective or standpoint) of when or how the global climate *began* to change into a problem, as many histories have already done (see below). Instead, it asks how the recurring problem of climate change first *became global*.

This chapter takes as its foundation three starting assumptions, both common and axiomatic in IR when adopting the catastrophic narratives of climate change and nuclear war noted above: (1) That the "'Global' refers to everything happening worldwide" (Weiss 2013, 28), making a global threat "lethal and planet-wide", affecting every state

and human being (Cerutti 2012, 317). (2) Global climate change must also, therefore, result "from an acceleration of the same global chemical and biological processes that have protected life on Earth for millions of years" (Weiss 2013, 79). In other words, what IR perceives to be new and pertinent about global climate change is its recent politicisation, rather than its naturalness or global nature. Its globality is understood to be axiomatic. (3) There is indeed a widespread recognition and acceptance that global climate change emerged in IR and global governance literatures as a problem in the late-1980s, after the formation of international regimes and institutions such as the Intergovernmental Panel on Climate Change (IPCC) in 1988 decided to take concerted collective action to combat it (Rowlands 1992; Brenton 1994).

With such a broad disciplinary range, scope, and history, this chapter will first provide a condensed (and admittedly presentist, Western, and Eurocentric) history of the general concept of climate change. This section is not intended to be a critical or comprehensive overview of the entire concept of 'climate', because this task would far exceed the scope of a single chapter, let alone an entire thesis. In accordance with this genealogy, this short history is to establish (1) a baseline of how and why climate change is commonly understood today as it is, and (2) how this chapter's tracing of climatic discourses in *Bulletin* offers a new and alternative problematisation of this referent.

A Brief History of Climatic Change

Contrary to popular belief, the climate was not always global in scope. It was typically interpreted in a variety of different ways by different cultures and polities in disparate geographies and environments. Previously, there was no such concept as a global nor planetary climate, but only a multitude of local, regional, and 'sovereign' state climates (these are also detailed in chapters 4 and 5). That is, until after WWII, when the "post-1950s era of satellites and computer models and a globally connected network of institutions and practices" enabled a new construction of a global climate to slowly congeal (Hulme 2010, 560; Miller 2004).

Histories of the climate's change from regional to global spatialities, and its science, politics, and governance, have occupied many books that may be consulted for a general historical overview (for a small sample, see Fleming 1998; Hamblin 2013; Weart 2003; Bolin 2007; Stevens 1999; Edwards 2010; Behringer 2010; Ruddiman 2010; Lamb 1995; Brooke 2014; Flannery 2008). The brief history of climatic change offered in this section highlights only the transitions made from a politics of plural regional climate(s), to the difficulties of calculating single global climatic referent.

In pre-Socratic Greece, the word κλίμα, or *Klima*, was used in the sixth century BCE by Parmenides "to differentiate between five zones on the surface of the supposedly spherical world" (Hulme 2009). The ancient Greeks were the first to make regular observations of, and derive theories of, weather and climate (Stevens 1999, 68). At this time, *Klima* or 'climate' as we know it today, referred to the slope or inclination of the Sun's rays upon the Earth's surface, depending upon one's particular region or latitude (Collingwood 1945). At this point, humans were imbricated with Nature, sharing its cycles and processes, and considering its presence as a part of human life and existence. It was Socrates that broke new ground by positing a theory of the human mind and its operation as being *external* to the world-organism of Nature and the body (*physus*). Under this guise, with *Klima* existing separately from the human being as an external variable that could affect human behavior, Aristotle soon claimed that the mind and "the vapours and exhalations of a country" were linked to the quality of air and climate (Fleming 1998, 11). He then produced the first comprehensive text written on weather and climate: the *Meteorologica*, from which our modern term 'meteorology' was derived (Aristotle 2017). This "became the Western world's reigning authority on weather for more than two millennia" (Stevens 1999, 69). Likewise, Ptolemy then extended the ancient Greek idea (*eidos*) of varieties of physical climates depending upon place and latitude, by developing it into seven *klimata* that "persisted as the conventional framework for explaining different climates" from the second century AD to the Renaissance period (Hulme 2009, 5). In general, where civilisation flourished, the climate was assumed to be politically civilised in kind. Where civilisation perished, the climate was therefore savage.

In the Middle Ages, however, regional climates rather than the latitudes of *klimata* made important political and cultural inroads upon Western societies. In Old Europe, for example, the crime of witchcraft replaced fears of epidemics depending upon climatic conditions. The "persecutions of inner enemies for their supposed influence on the physical environment" allowed a politics of blame to explain climatic changes. So, during a long and cold period eliciting famine and starvation, the "emergence of a new crime [witchcraft] was closely connected to the waves of climatic hardship during the earlier phases of the Little Ice Age" (Behringer 1999, 336). Witch-hunts reached their peak in the 1630s during the Thirty Years War, connected directly to fears that witches manifested this onset of climatic political instability and its concomitant political turmoil. As the climate warmed again and the 'Little Ice Age' came to an end in Europe, the crime of witchcraft dissolved into a more academic interest: how human behavior or sin might impact local and regional climatic conditions. It was, Behringer notes (1999, 345), "more than a mere metaphor that the sun of the Enlightenment ended the era of witch-hunting" in Europe. With climatic stability having returned by the end of the seventeenth century, judges dismissed cases of witchcraft with cheerful remarks that there were no laws against flying (Neumann 2006, 98).

With the arrival of the Enlightenment, new observations of foreign lands and foreign climates such those of the New World, appeared. The presence of indigenous peoples and their societies made it clear to Europeans, eager to expand their territories through conquest and imperialism, that it was possible to prosper in more than the temperate latitudinal climates originally determined by Aristotle and Ptolemy. Led by the scientific principles of Newton and Galileo, and the philosophy of Descartes, "This is where Modernity begins for many purposes", notes Toulmin (1990, 9) "… the historical phase that begins with Galileo and Descartes's commitment to new, rational methods of inquiry." For the first time, under this new metaphysical understanding of Nature as measurable in relation to a subjective 'I' (see chapter two), the climate became an *object of* scientific inquiry that could be measured according to objective scientific principles, and related back to the human subject. Just like human subjectivity, "Descartes provided

the governing philosophy and the general method that ever since have formed the basis of modern science, including the science of weather and climate" (Stevens 1999, 72).

However, just as it was possible to prosper in foreign climates, so it was also possible to be debilitated. Although still regional in scope, objective and measurable climates now became even more politicised at this time in forms of climate determinism (Sörlin 2009). Polities and peoples were now accepting that regional climates could change, but not through any human act or agency. It was now the inverse. As Greek thought merged into the classical era, a "widely held view" came to assert, to take one example, that Mediterranean travellers would turn black at the Equator, or else die. "The experience of encountering forbidding climates through journeys into unexplored territories, and the anxieties of such climatic encounters", thus exerted a powerful divisionary force between rival polities (Hulme 2009, 38). One did not want to inhabit their rival's climate, lest they become their rival.

This determinism spread throughout Europe quickly. For example, noted diplomat and historian Abbé Jean-Baptiste Du Bos's 1719 *Critical Reflections* claimed that a favourable climate stimulated genius in certain nations by infusing the human being with their local air, soil, and water. This distilled nationalities with a specific "cultural vintage" like a fine wine. "During the life of a man, and as long as the soul continues united to the body," Du Bos wrote, "the character of our minds and inclinations depends very much on the quality of our blood . . . [which] depends vastly on the air we breathe; . . . Hence it comes, that people who dwell in different climates, differ so much in spirit and inclinations" (1748, 177-178). Different nations have different characters, therefore, because of their different sovereign climates. Montesquieu (cited in Fleming 1998, 16-17) echoed Du Bos's warning of changing climates, advocating in 1748's *The Spirit of the Laws* that a "good life" could only be lived within the same climatic region and country, because a nation's geographic location determined the spirit of its politics. A bad sovereign climate, therefore meant a bad state, and bad citizens.

With this in mind, the colonisation and industrialisation of America was conducted with the intention of *facilitating* anthropogenic regional climate change(s). It was believed that a human-induced warming of regional climates would make the American wilderness suitable to the advancing white European civilisation. Deforestation, for instance, would ameliorate the American climate to "make it more fit for European-type civilization and less suitable for the primitive native cultures" (Fleming 1998, 18). Manifest Destiny *as* regional climate change quickly became part of the American Republican national ideal, as expressed by John Adams, Benjamin Franklin, and Thomas Jefferson, who are credited with taking the first meteorological measurements in America. Utilising new Enlightenment tools and mathematics to document weather through the recording of data, "Throughout his life, Jefferson maintained that human-induced climate change due to settlement would be proved by extensive measurements", and would thus increase the use of American land for settling and agriculture (Fleming 1998, 33).

What was lacking, however, was a way to document this climatic change. This is where population arithmetic enters climatic observation. In 1686, Edmond Halley had sought to go beyond the latitudinal zones of Ptolemy by theorising that warmer air rushed to the equator, creating the trade winds required for navigation. "Halley's term 'circulation', as well as his notion that the atmosphere must 'preserve the Æquilibrium', remains in use today" (Edwards 2011, 128). Like Halley, in *Les Meteores* Descartes attempted to show "that the weather can be explained by the general physical principles that be believed determined the physical behavior of the universe" (Stevens 1999, 72). The elaboration of these principles fell into error because of a lack of quantitative and calculative tools that could go beyond sensory perception to grasp the complexity of atmospheric physics (Stevens, 1999, 72). Later, as quantitative and data-driven forms of observation got underway, a mathematised and physics-driven understanding of climate emerged as laws were reduced to mathematical expressions. Finally, "this meant they could in theory be combined with data to analyze and calculate the behavior of the atmosphere" (Stevens 1999, 77).

Just like the application of physics to the state (Foucault, 2007), applying basic physical laws to the climate transformed how it was understood scientifically and politically. Like governmentality, statistics catalysed the discipline of climatology because "statistics extracted from the data made it possible, for the first time, to look for patterns and cycles in the climate's behavior" and to hence to identify their laws (Stevens 1999, 82). State-led initiatives to systematise and standardise "the physicality of climate" through national and international networks of meteorological measurement and observation, quickly appeared (Hulme 2009, 6). By 1839, the study of climate was, according to Oxford's John Ruskin of the Royal Society, "not for a city, nor for a kingdom, but for the world. It wishes to be a central point, the moving power, of a vast machine, and it feels that unless it can be this, it must be powerless; if it cannot do all, it can do nothing" (Quoted in Fleming, 1998, 35).

To make an international climate viable, states now required extensive cooperation grounded upon uniform scientific measurements. As calculable spaces became larger, the need for international integration increased. Through the standardisation and codification afforded by statistics, "the key to good government," it was "only through quantifiable data and statistical research that one could uncover the laws of progress, in society as well as in nature" (Mazower 2012, 100). Prior to World War I, however, climate science had hit a wall engendered by the human condition itself: statistical calculations now took months to complete by hand, and "numerical techniques capable of approximate solutions" to the mathematical models of atmospheric dynamics proposed earlier by Norwegian Vilhelm Bjerknes' "primitive equations" model, and Lewis Fry Richardson's "numerical forecasting method", were simply impossible to create due to their complexity (Edwards 2011).

Indeed, Bjerknes and Richardson had formulated brilliant mathematical models, basically dividing regional (and then by extension, global) climate(s) into a series of 'Cartesian grids' comprised of primitive notions of motion and state. In them, "mass, momentum, energy, and moisture are conserved in individual interactions among individual parcels of air", much like today's GCMs. The problem, however, was the

inability to compute and calculate the interaction of these Cartesian grids. Prior to World War II, these painstaking calculations were completed almost by hand, and took weeks at a time. Finally, in the 1930s, "These problems led meteorologists to abandon numerical modeling for the next two decades" (Edwards 2010, 130). Calculating the nonlinear fluid dynamics of regional climates, in other words, went far beyond the abilities possessed by a human being. In their place, *geological* inquisitions into ice ages, soil, and sediment deposits, popularised notions of climatic change only in geological timescales considering ice ages lasting thousands of years. Glaciology was thus the main representative of climatic change throughout the first half of the twentieth century (see Kunzig and Broecker 2009).

Up to the 1960s, therefore, a popular notion of global warming or climatic change resulting from CO_2 or carbon emissions, simply did not exist. Climate change was made of *ice* and ice ages spanning geologic epochs, and no human agency was detected within it. Indeed, "geophysicists studied phenomena within a region, often not even a nation but part of a nation" (Weart 2003, 35), and anyone interested in climate change was focused on geologic scales and the ebb and flow of massive ice sheets across continents.

This is an important point: despite common narratives in IR and the social sciences today claiming that, "when Swedish chemist Svante Arrhenius published his path-breaking work on human-induced climate change in 1896, the problem [climate change] was articulated with reference to the global flows of carbon between the atmosphere and the oceans" (Methmann 2012, 9), *there was no such agreement amongst scientists nor did it exist in public awareness*. Nor, in fact, did Arrenhius's work on CO_2 regain attention until well after World War II (Fleming 1998; Weart 2003). In fact, even as late as 1969 (as will now be explored below), *Bulletin* admits that it was unsure how climatic change was actually caused. "How may all these fluctuations of climate be explained? Numerous hypotheses exist, . . . Consequently the search for the answer continues" (Borisov 1969, 44). Well into the 1970s, therefore, "The basic causes of these variations in the global climate machine are as yet unknown. Many suggestions have been offered,

but we must learn much more about how the [vast] machine works before basic causes can be reliably evaluated" (Fletcher 1970, 44).

Why was the CO_2 theory of climatic change not accepted nor popularised, until well into the 1970s and 1980s? Knowledge of atmospheric fluid dynamics remained rudimentary until John von Neumann, a scientist "deeply involved in the Manhattan Project, selected weather forecasting over many other possible applications for the earliest electronic digital computers" whilst working at Princeton University after WWII (Edwards 2012). To resolve the impossibility of calculating by-hand the nonlinear fluid dynamics of the atmosphere, with one of the first digital computers, von Neumann created one of the first GCMs. Yet these GCMs were not designed for any climatic change, but were primarily applied to fluid dynamics equations analysing shock waves from nuclear explosions. It just so happened that these were very similar to simulations of atmospheric motion, and hence, could be applied – only later on – to what would become the 'global' climate, too. Hence, after WWII, based on the work of von Neumann, generations of nuclear weapons designers and climate modellers began their studies from the same textbook: Richtmyer's *Difference Methods for Initial Value Problems* (1957).

From its outset, therefore, the capacity to simulate atmospheric dynamics required for modern meteorology and climatology – the knowledge and concepts operating from its scientists, to its GCM supercomputers, to its funding – began within military and state projects seeking to understand and weaponise Nature so as to gain tactical nuclear superiority (Edwards, 2010; Hamblin, 2013). With this in mind, it is to the pages of *Bulletin*, and its discussion of nuclear (and eventually) climatic catastrophes, that this chapter turns so as to trace and interpret the interaction of nuclear and climate discourses.

The Problematique of Our (Nuclear) Climate: One World or None

After the atomic devastation of World War II, there were general calls in academia and the public alike for a form world order. Recognising how the selfish behavior of states could lead to atomic chaos, it was now thought that a world order or world state could "avoid the most fearful [atomic] catastrophe" by appealing directly to the conduct of individuals. Citizens could thus be of a shared world, rather than of many particular and divisive nationalities (Woodward 1949, 23). As Rienhold Niebuhr phrased it, until some type of world state developed, it was only grace or chance that could prevent "self-annihilation until the day when humanity regained control of the trials and travails of modern society through some form of global polity" (Bartel 2015, 276).

This chapter argues that this "global polity" has been realised today (see Neumann and Sending 2010; Corry 2010), albeit *implicitly* as a form of governmentality. It is both subjectified and objectified within the concept of global climate change and the Anthropocene. Hence, when climate scientists now comment that "Climate change has become a new condition around which human life takes shape", and through which all meaningful narratives can be re-evaluated (Hulme 2014, x), they are fulfilling the wishes of atomic scientists long since past, for a type of world order that orders individual conduct.

Written concurrently with the inception of *Bulletin* in 1945, an American publication entitled *One World or None* first appeared on bookshelves in 1946. It was "written by a team of scientists which [included] many of the men who co-operated to produce the bomb which has fatally affected the destiny of mankind on our planet" (Davies 1947). The book hoped to awaken "mankind" from its doomed existence by publicizing "the ultimate, simple fatal fact: that the existence of man as a civilized, social being is at stake" (Davies 1947, vii). Humanity's existence was now threatened like never before due to the invention of the atomic bomb, the destructive power of which was "sufficient to raze every town and city to the ground; sufficient to reduce civilization to dust and rubble" (1947, viii). A sense or rationality of powerlessness amongst scientists and

politicians took hold here: "In the presence of this new peril which menaces mankind, science, *on the confessions of the scientists*, is impotent. It reaches the end of its tether. Science has invented the means by which civilization can be completely destroyed" (1947, ix, emphasis original). The sovereign state, in other words, in its drive to succeed militarily, had sowed the seeds for its own destruction through the invention of nuclear technology and its concomitant annihilation.

In 1946, the solution set forth to ameliorate fears of existential catastrophe from "atomic fire" were not of a global, but of a *world* nature: "The worldwide growth of science and technology is the main line of the rapid evolution of man", wrote Compton, "…into a social being whose community is the world. . . . It is a part of our age-old quest to use the forces of nature for shaping the world according to our desire" (1947, xi).

"Catastrophe", therefore, lay ahead if traditional forms of national sovereignty and self-defence were not socially adjusted and manipulated on a planetary basis. "What are the practical possibilities of international agreement that can make us safe in a world of atoms?" scholars and states asked (Compton 1947, xii). Theoretical physicist Robert Oppenheimer, the lead scientist of the Manhattan Project that developed the atomic bomb, claimed that despite the "rapid development" of atomic weapons being "made possible only by the extremities of the war and the great courage of the governments of the United States and Britain" (1947, 56), the state was now being made obsolete by the reality of nuclear war. "The release of atomic energy constitutes a new force too revolutionary to consider in the framework of old ideas. . . [demanding] radical and profound changes in the politics of the world" (Oppenheimer 1947, 53). The best possibility for agreement in this world of atoms, was thus a new world order or world state (see Cabrera 2015; Bartel 2015).

Planetary totality was now recognised as being irreconcilable with state sovereignty. Ironically, Oppenheimer hoped that the example of international scientific collaboration and "fraternity" used to *create* the atom bomb would serve as an exemplar for states "to transcend the accidents of personal or national history", illustrating that "in its

application to the problems of international relations there is novelty" (1947, 57). Other scholars agreed that, through the specter atomic catastrophe, "We stand at the gateway to a new world" (Laurence 1947, 226), because "atomic science is a potential source of great good" that conducts "the natural grouping of people" according to a "worldly authority" (Loewenstein 1947, 16). So, nations of the world, unite: the "re-education of those nations which have been in the past the greatest menace to world peace. . . [reveals] the solution of the entire problem—to create a united Europe" (Harper 1947, 67). Even beyond Europe, calls for a "Union of the world . . . a universal State" abounded, in which "the nations of the world must cease to exist as independent States" through "the abolition of the sovereign State [and its] national army and national assets" (Leary 1947, 84). And in IR, even the LSE's F.S. Northedge joined this chorus of voices clamouring for a new world order (Northedge 1971, 4). The point is, long preceding today's calls for a planetary politics of the Anthropocene, to solve the threat of world atomic catastrophe in a Nature controlled or affected by "mankind", it was common to hear that "people will have to drop the *national* attitude and will have to think in terms of internationalism, and live, not in terms of countries or continents, but in terms of *one world*." (Bhargava 1947, 118, emphasis original).

A dissenting voice from this chorus is worthy of note here. Writing in *One World or None*, journalist and political commentator Walter Lippman compared these world order discourses to the failure of collective security in the inter-war period. "For [international rules and inspection] agreements are not likely to be observed if men do not have reason to believe they will be enforced. The stakes are the life and death of national states and of masses of their inhabitants", he wrote (1947, 134). Indeed, echoing today's lament in IR and climate governance scholarship about the tragedy of enforcing emissions regulations in the global atmospheric commons (Harris 2013), Lippman stressed that no state would comply with atomic regulations and inspections without the absolute certainty that all other states complied in identical fashion (1947, 134). Interestingly, this certainty was as paradoxical as it was impossible, "Because the remedy is as bad as the disease: the peaceable nations have to be willing to wage total war in order to prevent total war" (1947, 136). Instead of conceiving of a world-spanning sovereign,

community, or order along lines of Wilsonian collective security, therefore, he outlined the impossibility of building a world-state from out of a political rationality always thinking *in terms of* sovereign states. The failure of collective security was "an admission on their part [states] that out of sovereign states alone a world order cannot be formed" (1947, 147). Instead,

> …the traditional and orthodox doctrine . . . [of] the theory of the absolute sovereign state that is subject to no higher law, and is itself the source of the highest law of its people, is an aberration and a heresy, which has flourished, though even then never without protest, during the closing decades of the nineteenth and the opening decades of the twentieth century. (Lippman 1947, 148)

Lippman was arguing that sovereignty could be overcome through a shared rationality and conduct. Indeed, "the essential political principle is known by which our problem [nuclear catastrophe] can be solved. . . . The principle is to make individuals, not sovereign states, the objects of the international agreements; it is to have laws operate upon individuals" (1947, 137). He used the example of the Nuremburg tribunals and their prosecution of select German officials as war criminals (rather than grouping the people, *volk*, or nation as one), to argue that *individuals* could be subject to a world order rationality transcending the sovereign German state. Although preceding Foucault's Collège de France lectures on governmentality by three decades, Lippman was here arguing that world government came not from sovereign or top-down forms of disciplinary power, but through the shaping of ideas and conduct operating upon persons at the individual and subjective level (1947, 149). Only through this subjective recognition of a "truth" deemed relevant to their current world situation, therefore, could a world state form from the bottom-up (1947, 149). "For when an idea that enlists men's hopes is seen to be consistent with their acts, it evokes and organizes their energies", he wrote. "It is not then an abstraction or an essence. *It is a dynamic force in their conduct*. There are the ideas that shake the world and change it" (1947, 149, emphasis added).

Lippman's unique claim regarding the shaping of *individual and subjective* (world) conduct was quickly overshadowed by more topical arguments embracing postwar sentiment. Familiar here are Albert Einstein's calls for a supranational organisation replete with military powers (Einstein, 1947), and by The Federation of American (Atomic) Scientists, who likewise stressed that "The problem is a world problem. There can be no merely national solutions . . . nations must collaborate for the development of the new force [nuclear power]" (1947, 157).

From out of this declaration, the Federation of Atomic Scientists continued to mediate between theoretical nuclear physics and the politics of world order, in the pages of *Bulletin*. This chapter will now trace how physics, the climate, and politics intersected in its pages, detailing how the political drive towards a world state or world order transformed over time, in the minds of physicists, politicians, and social scientists alike: from an atomic world state, into a global climatic change wrought by a nuclear winter. Readers should keep in mind that, although the explicit claims of Einstein ring through *Bulletin's* pages, Lippman's call for a subjective world rationality of some kind is seen to slowly crystalise in the background.

The *Bulletin:* From an Atmosphere of Opinion to a Climate of Change

The *Bulletin of the Atomic Scientists* was founded in 1945 by atomic physicists and scientists that worked on the Manhattan Project, yet "could not remain aloof of the consequences of their work" (*Bulletin* 2016, online). It condenses scientific and policy analyses into "language that is accessible to high government leaders and everyday citizens alike, with the rather ambitious goal of saving humanity from itself." (Mecklin 2015, 10). Today, it considers itself as "bridg[ing] the technology divide between scientific research, foreign policy and public engagement" with the goal of influencing public policy to "protect our planet and its inhabitants" (*Bulletin* 2016, online).

At its outset, this chapter noted how global climate change recently displaced nuclear war as the direst global threat facing the planet today. It will now argue that this

contemporary and naturalised understanding of climate change emerged only very recently; not alongside, but *through* the concept of nuclear war. The text of *Bulletin*, therefore, serves as an excellent archive through which to trace the 'permanent correlative' of physics and politics once described by Foucault (2008. See chapter two), as nuclear physics is translated into rationalities of nuclear war and climatic change.

The *Bulletin*'s first issue on 10 December, 1945, is ripe with familiar narratives concerning the "continuous dread of sudden annihilation" of the human species. "This catastrophe [nuclear war] will be inevitable if we do not succeed in banishing war from the world", and so all states and "big nations are aware that an agreement on atomic power controls must be reached if our civilization is to survive" (*Bulletin* 1945, 1). The only form of "climate" mentioned at this period of atomic angst, however, was not atmospheric nor geophysical, but *psychological* or *mental:* peace could only be secured by "keeping our own unrealistic fears . . . in rigid control", and "strengthening the world climate of opinion which already condemns these aggressive acts [of war]" (Bateson 1946, 11). The 'climate' as a geophysical concept was not used, but instead, referred to the psychological atmosphere of the time: the genuine concern towards understanding the mentalities underpinning arms races in contrasting states, so that "detailed studies of the specific psychology of the people and leaders of all the nations concerned" could be "disseminated to the thinking and planning people all over the world. . . . [and] at a more popular level so that the peoples may be a force" powerful enough to affect state policy (Bateson 1946, 11). The climate was discerned as a mental proclivity for nuclear war.

This type of climate, as a frame of mind or "mental state", continues to be used in the *Bulletin* throughout the decade. For instance, to "change the climate in the research laboratories" and "the American climate of opinion on the subject of free enterprise" (Cohen 1948, 10, 11); the effect of McCarthy-esque loyalty tests on the American "mental climate" (O'Brian 1948, 172); the "present climate of enmity and suspicion between the United States and the Soviet Union" (Bulletin 1948, 129); and the need for the "creation of a climate favourable for public action", since "Our hope must rest with the peoples", not the politicians (Marks 1948, 274).

Throughout the 1940s, although the potential to unleash "apocalyptic" annihilation remained bound to states, the scientists and politicians in *Bulletin* sought to alleviate catastrophe by proposing a reorientation of political sovereignty along familiar lines: by linking the bottom-up aspirations of citizens, to a top-down authority in the form of world government. It even went as far as trumpeting and displaying a "Preliminary Draft of a World Constitution" for a universal-federal world republic, a supposed "milestone on the road to a democratic federation of the people of the world" (Committee to Frame a World Constitution 1948, 145). This belief in a unity of "mankind" and the potential for world-citizens to pledge sovereign allegiance to a universal or federal world government, mirrored the belief that mankind also had its finger on the new nuclear trigger. Ultimately, through the state, humans could choose their fate, whether that was world-unity or existential annihilation. Unity went hand-in-hand with catastrophe, but it also created newfound notions of planetary control: "It would appear that in the long history of geologic life development", wrote Mather, preceding today's discourses of the Anthropocene, that "man is the first creature possessing the ability to determine his own destiny" (Mather 1950, 208). Hence, the current moment "and the decisions made in these years may well shape the course of human history for many generations to come."

The calls for a world government by establishing a shared world "psychological climate" remained steadfast throughout the 1950s, as the nuclear bipolar rivalry between the USA and the USSR intensified (Rabinowicz 1954, 319). Technological, scientific, and political agency remained firmly within the hands of policymakers, however. As Hans J. Morgenthau commented in *Bulletin* in 1954, the only climate to change remained within "the minds of men", rather than anything pertaining to the geophysical or planetary atmosphere. "Finally, atomic war is no longer, as was traditional war, an instrument of rational policy," he lamented. "[R]ather it is a means of universal destruction and, as such, a last resort of desperation" (1954, 325). In 1958, *Bulletin*'s issue on the International Geophysical Year (IGY) asserted that the causes or mechanisms driving climatic changes witnessed in geological records remained unknown to scientists. Despite weather being the "most important" of IGY phenomena

being examined, “it has never been possible to study the circulation of the Earth’s atmosphere with an adequate amount of data”, so the impact of radiation and heat in the atmosphere, with “regard to climate change, are still unanswered questions” (Sullivan 1958, 72). The only ‘global climate’ at this point, therefore, remained the mental climate of opinion surrounding planetary atomic annihilation.

An interesting shift occurs in the 1960s when scientists and policymakers begin to combine the human agency and psychology underlying “mental climates” of nuclear war, with the climate as a geophysical system. Now, questions arise over whether nuclear war could alter the world’s (physical) climate. “Have atomic bombs changed the weather?” Landsberg asks, in an article questioning the possibility of using weather and climatic control to suit “mankind” (Landsberg 1961, 370). “Now that man has moved, over millennia, from his tropical habitat to all parts of the globe, it would be a good thing if the entire global climate could be made comfortable and pleasant” (1961, 370). And yet, he is quick to dispel how “many people think man has already changed the earth’s climate”, highlighting that, out of the previous climatic changes ascribed to human influence (i.e. as punishment from the displeasure of one’s gods, cannonade fire during the US civil war and World War I, and nuclear explosions), “None of these imputed relations can stand up to objective calculations and statistical tests” (1961, 371). So, “sweeping global climate changes”, as wrought by the agency of man, therefore, “appear to be some distance in the future” (1961, 371).

Oddly enough from today’s presentist/finalist standpoint, Landsberg’s argument is reiterated and reinforced by someone whom today’s typical narratives of climate change credit as one of its discoverers: physicist Hans E. Suess. Today, Suess is most famous for rekindling the CO_2 theory of greenhouse warning, writing a landmark paper with Roger Revelle in 1957 that claimed increasing anthropogenic carbon emissions meant that “human beings are now carrying out a large scale geophysical experiment of a kind that could not have happened in the past nor be recreated in the future” (Revell and

Suess 1957, 19).[1] This famous line is still echoed in climate governance treaties today. However, in *Bulletin* Suess likewise notes the potential role that carbon dioxide could play in climatic change, but also states that "A comparison of CO_2 analyses in air done in the 19th century with those of today is inconclusive because the older analyses are not sufficiently accurate" (1961, 374). He even highlights that "It seems improbable that the small increase in atmospheric CO_2 which can be assumed to have occurred since artificial coal combustion began has affected the climate of the earth in any appreciable way." Again, contrary to the established linear narratives of global climate change histories common in IR and the social sciences today, it was clear that even Suess, as recently as the 1960s, remained unsure of how Earth's climate actually changed. There are also no catastrophic overtones, nor mentions of national unity or world sovereignty, in his 1961 *Bulletin* contribution.

This is an important moment, however. In 1961, Suess highlights what may be considered an essential and central, yet now implicit and overlooked, turning point of conceptualising the climate as a *global* phenomenon. He asks: how is it possible, if "one might expect significant effects for the coming centuries, if combustion of fossil fuels continues to increase exponentially", to detect any changes scientifically on such a vast planetary scale? Indeed, theories of climatic change due to increased CO_2 emissions had been developed as early as 1861 by Tyndall, and backed up by Arrhenius (1896), Chamberlin (1897), and Guy Callendar (1939). However, and again contrary to today's IR narratives, none of these CO_2 theories of climate change had yet taken hold. Why?

Even well into the 1970s, climate science was never focused upon the effects of organic carbon or CO_2 on the Earth, let alone over timespans of decades or centuries. From its outset, climate science was focused on inorganic fields of glacial *ice* that covered swathes of the Earth on scales of millennia, pertaining to geologic time (Kunzig and

[1] Notably, both authors shared a past of atomic militarism. Hans Suess was an Austrian nuclear physicist that had worked on nuclear power projects for the Germans during World War II, whilst Roger Revelle had learned to study the movement of atmospheric radiocarbon whilst commanding a scientific mission for the US Navy during the atomic bomb tests at conducted at Bikini Atoll in 1946. Ironically, it was this new radiocarbon produced in atomic bombs, C-14, that was later proposed and used by Revelle and Suess to outline and trace the atmospheric fluid dynamics of what would become known today as the 'global' climate.

Broecker, 2009). In 1824, Joseph Fourier was actually writing about "the temperature of space" and only very generally mentioned, in personal reflections, how "the effects of human industry and all the accidental changes of the earth's surface, modify the temperatures of each climate" (Fourier 1824, quoted in Fleming 1998, 61) As Fleming asserts, "it would be a mistake, however, to consider either [Tyndall or Arrhenius] as direct forerunners or prophets of contemporary climate concerns", since each made their comments on CO_2 and climate change incidentally whilst working on other projects (1998, 65). Rather than carbon dioxide, both were seeking answers to the dominant geological problematique of the day: the cause of glacial incursions and retreats causing ice ages. They pursued this problem by working out tedious statistical calculations, by-hand. Indeed, Arrhenius's 1904 book *Worlds in the Making* describing the "hot-house theory" of the atmosphere due to anthropogenic CO_2 emissions, but this book was never widely read. Arrhenius did not have "any great concern for increasing levels of CO_2 caused by the burning of fossil fuels, and instead he was attempting to explain how "temperature changes at high latitudes could account for the onset of ice ages and interglacials" (Fleming 1998, 82).

By 1910, 'most scientists thought Arrhenius's hot-house theory "was altogether wrong" (Weart 2003, 4). Decades later, even T.C. Chamberlin reneged on his own "CO_2 theory of glaciation", which fell out of academic favour and discussion prior to World War I. As he wrote in 1913, "the number who accept the CO_2 theory is less now than a few years ago. . . . I greatly regret that I was among the victims of Arrhenius' error" (Chamberlin 1913, quoted in Fleming 1998, 90). Returning to Suess in 1961, this explains why even the world's leading climate scientists writing in *Bulletin* in the 1960s were not yet convinced of the 'CO_2 theory' of climatic change.

Rather than sample inconclusive pockets of interglacial air, Suess's solution to this climatic conundrum was to fuse the existential terror of planetary nuclear annihilation, *with* the geophysical world climate. "Bomb radiocarbon" (C14 or C-14) was suddenly set forth as a bridge between the two worlds of the planetary, and CO_2:

> Because of the introduction of artificial C14 into the atmosphere since 1954 by the testing of atomic bombs, radiocarbon measurements on modern material have now to be interpreted in a different manner. The bomb-produced C14 in the atmosphere could be used as an isotopic tracer to find out the rate of CO_2 uptake by the oceans.
>
> (Suess 1961, 375)

On paper, this had the effect of showing that CO_2 was not being absorbed and dissolved into the ocean at rates that those dismissing anthropogenic interference had argued. Instead, carbon was being spit back out of the ocean again (Kunzig and Broecker 2009, 89). Crucially though, this suspicion arose only by reconsidering the atmospheric particulates of nuclear fire. C-14 had now opened this contingent and unexpected possibility for revealing the physics of the climate: to use an anthropogenic and atomic form of radioactive carbon to discover and trace the predictability of natural, planetary, atmospheric processes.

Noted previously but briefly in *Bulletin* by Libby (1948), Suess now discovered that "measurements of natural radioactive carbon (C14) can give information on the CO_2 exchange and the rate of absorption into the oceans", thereby commenting on carbon emissions from humanity's burning of fossil fuels in a way never before possible (1961, 375). Without knowing it at the time, the byproducts of nuclear war had opened both the physical and conceptual foundation for concerns over planetary-wide atmospheric change. The means to discover climatic change were now outlined through human-made radiocarbon C-14, and its relationship to carbon dioxide. By tracing the effects of nuclear bomb particulates through GCMs, therefore, one could now trace particulate flows through what scientists began to call a 'global' atmosphere, or global climate.

Despite Suess linking the tracing of nuclear radiocarbon C-14 to what would *eventually* become known as the Earth's carbon cycle, the underlying rationality concerning climate change in *Bulletin* remained consistent into the 1970s. The climate discussed in its pages remained one of *opinion*. In 1969, despite a variety of explanations ranging from the Sun's radiation, to the Earth's rotation, to atmospheric composition,

"Nevertheless they [climate scientists] cannot account for the climatic transformations that have occurred so frequently in the polar latitudes," noted Borisov. "Consequently the search for the answers continues" (1969, 44). The linking of nuclear warfare to the climate was still strongly felt, however. Notions of a "*global* climate machine" were becoming commonplace, despite scientists disagreeing how this machine actually worked. "The basic causes of these variations in the global climate machine are as yet unknown", wrote Fletcher (1970, 43). "Many suggestions have been offered, but we must learn much more about how the machine works before basic causes can be reliably evaluated" (1970, 43). Interestingly, despite the nuclear threat remaining and intensifying, calls for world government and the dissolution of sovereignty had drastically subsided since their peak in the 1940s. They were replaced now by discourses of international cooperation, emphasising that "management of climatic resources is a problem shared by all nations" (Fletcher 1970, 47). At this point, an implicit connection between the planetary scope of nuclear fallout, and its potential to trace CO_2 processes in the oceans and atmosphere, had allowed a lexical transition from 'world order' to a concept of 'global climate' now subtly entering *Bulletin*.[1]

Despite IR scholars today asserting the globality of climate change and the Anthropocene through analogies with the Apollo missions and photographs of the whole Earth (van Munster and Sylvest 2016), humans were landing on the moon in 1969 long before *Bulletin*, and the public writ large, were seriously discussing if CO2 from fossil fuel emissions could cause a 'global warming'. Rather, a new question concerning 'global' atmospheric change *did* arise at this point in time. It comprised a vigorous debate amongst climatologists and politicians in the media questioning whether increased CO_2 emissions could lead to a global warming, or if the increase of pollutants

[1] It is important to note that many international environmental problems were emerging and gaining political traction at this time, due to a confluence of events such as the IGY in 1958, the publication of Rachel Carson's *Silent Spring* (2002 [1964]), the crash of the *Torrey Canyon* oil tanker, concerns over resource depletion and overpopulation, and the onset of increased technological and economic interdependence indicative of early stages of globalisation. The point here is that, even well into the 1980s, climate change was absent from these discussions and debates. In IR, for example, Richard H. Falk's *This Endangered Planet* (1972) remains a key text documenting the spirit of these times. However – and in accordance with the argument set out here – there is no mention of climate change in Falk's 494 page book, because the concept of 'global climate change' was not yet publicly or academically known or relevant.

and aerosols due to postwar industrialisation could lead to a planetary cooling. “Our understanding of the forces that move the major climate systems of the earth is even more primitive”, wrote Young (1977, 274), as he observed that trends of planetary warming stalled in the 1970s and trended downwards. This did indeed lead many climatologists and scientists to prophesise a coming ice age and a climatic change of *global cooling* (Calder 1974; Ponte 1976; Bryson and Murray 1977). And it was at this time that the news media discovered the attention-grabbing power of sensationalist (catastrophic) environmentalism.

In 1975, a headline in the New York Times by *Bulletin* contributor Walter Sullivan read that “Scientists Ponder Why World’s Climate Is Changing; a Major Cooling Widely Considered to Be Inevitable” (1975, 88). Sullivan wrote that “Hints that it may have already begun are evident”, and potentially caused by solar variations, atmospheric pollutants, and a widespread acknowledgement that the Earth’s own geological cycle was due for another cyclical ice age (1975). Notably, Sullivan’s article reflects a new but divisive split between *types* of global climate change: one caused by an increase in CO_2 that warms the planet, or another caused by pollutants and aerosols that create a global cooling. Despite noting the 4% rise in CO_2 concentrations between 1958 and 1972, “That, however, was a period of global cooling—not the reverse, as one would expect from a greenhouse effect.” Hence, “a steady rise in atmospheric turbidity—the extent to which particles overhead dim the brightness of the sun . . . [caused] by human activity over the last 120 years has contributed more to atmospheric dust than volcanic eruptions” (Sullivan 1975, 92). Indeed, even in 1975, not just the cause, but also the *direction* of a climatic change was deemed unknowable: “The Academy of Sciences report notes that any assessment of climate trends is crippled by a lack of knowledge: ‘not only are the basic scientific questions largely unanswered, but in many cases we do not yet know enough to pose the key questions’” (Sullivan 1975, 92).

Global cooling was not, as it is commonly used today by conservative organisations such as the Heartland Institute, a tool of climate change denialists nor propagandists that is intended to mislead (Elasser and Dunlap 2013, 764). It is worth noting that even some

well-intentioned climatologists did claim that particulates and dust would outweigh CO_2 in shaping the planet's climate, by reflecting the sun's energy away from Earth to cool it: "An equation for the relationship between dust and carbon dioxide in the atmosphere, and surface temperature in the Northern Hemisphere . . . indicates that dust accounts for perhaps 90 percent of the temperature variation, while carbon dioxide accounts for only about 3 percent." (Bryson and Murray 1977, 152). Indeed, even Stephen H. Schneider, known today as one of the world's best climate scientists hazarding a disastrous future of CO_2 warming, was writing in 1976 that cooling was a possibility: "climatic theory is still too primitive to prove with much certainty whether the relatively small increases in CO_2 and aerosols up to 1975" caused any discernible climatic change. Hence, he wrote, recent cooling trends could signal a sign of greater temperature decreases to come (Schneider 1976, 10).

The intensity of this 'warming v. cooling debate' is discounted and even denied by some scholars and climatologists today as a "myth" (Peterson et al. 2008). However, this chapter finds that, despite what is indeed incorrect science from today's presentist standpoint, in the context of the 1970s notions of 'global cooling' had an important and significant effect upon public and scientific discourse. In the early 1980s, the global cooling theory was quickly dismissed by digital advances in climatology, courtesy of more advanced GCM simulations and digital computers with smaller and finer grids for 'parameterizations' of detail (IPCC 2013. See chapter 4). Crucially though, what emerged from 'global cooling' was a concept of a changing global climatic object that was *separate* from its previous conceptual foundations that were anchored firmly to the state, nuclear war, and the radionuclide C-14 atoms generated from bombs and used to trace atmospheric patterns.

Arguing for global cooling due to "manmade dust", Bryson and Murray declared that "During the twentieth century we have come to recognize that humans must be added to the list of forces that can change climates throughout the world" (1977, 152). In this sense, once this version of global cooling emerged in the early 1970s as a non-nuclear concept, 'global climatic change' became up for conceptual grabs, since it was no longer

the state, war, and discourses of sovereignty as the sole agent or driver of global and climatic annihilation (i.e. as evinced in the world order discourses noted above). Now, the rationality of instrumental choice and psychological control plaguing previous nuclear and statist considerations and calls for world orders and world states, also wavers: "There is more to our lives and to the course of nations than climatic change. . . But our environments do set limits. . . We cannot expect to control the forces that affect climate", Bryson and Murray lamented. By understanding anthropogenic global cooling, humans can "realize the limitations that the earth" places on human numbers and actions (1977, 155-156). The *Bulletin*'s response to the global cooling debate was slight, with Hall (1975, 16) arguing – whilst citing Bryson's studies on global cooling – that "anthropogenic dust" *and* carbon dioxide could affect the biosphere and reduce global agricultural production. But now, regardless of whether Earth was cooling or warming, its fate was not simply determined by states, nuclear bomb fallout, and radiocarbon. The climate was being impacted by the actions of (Western, industrial) humanity, using something as simple as aerosol spray-cans and refrigerators, which amounted to a new form of unintended planetary agency into atmospheric dynamics.

This separation of climate change from radioactive carbon in the global cooling debate fostered two important transitions in the way that statist political rationalities perceived climate change. First, as the debate died down in the early 1980s, there was a return of the state as the agentic actor responsible for global welfare. Writing in 1981, Friedman and Schware (1981, 56) note that climate action regarding CO_2 emissions depends on "future decision-makers, . . . to see that our information about the climate system, as it affects socio-economic activities, is applied most appropriately." They admit that major unsolved problems concerning the computing power of GCMs to parameterize precipitation, evaporation, and oceans, prevent conclusion declarations regarding global warming; yet, they stress that despite this "nations can even act unilaterally to minimize the effects of significant, and at present unpredictable, global changes." In other words, this was not the urgent bottom-up appeal to individuals made in the 1940s; here, states regained their prestige as world actors, and calls for one world dissipated amongst the

public and policymakers, whilst remaining strong amongst disarmament advocates (see Schell 1982).

Secondly, and most importantly, the portent of global catastrophic change and nuclear holocaust re-enters *Bulletin* very prominently. Now, however, it is no longer a fallout from nuclear weapons that is discussed, but the *global climate* that provides the ultimate basis, scope, object, and foundation for the prospects of a future annihilation in a *nuclear winter*. Indeed, in 1979, we see "global cooling" re-enter political discourse in a powerful new way. Not, however, attached to aerosol particulate pollution *nor* to ice ages. Now, it is because "Ground-burst nuclear explosions throw great quantities of gravel and debris into the atmosphere . . . for years" – including debris and suspended particulate matter that blocks the radiative energy and sunlight needed to warm the Earth's surface – that nuclear war "can lead to global cooling" (Kendall 1979, 36). The objective here was to fear the global climate itself.

An unfamiliar connection between nuclear war and global catastrophe as starvation, also appears. "As a result [of nuclear winter] the possibility of climatic changes of a very dramatic nature can by no means be ruled out. . . . Climatic alteration would directly affect the growing of food in virtually every nation on earth" (Kendall 1979, 36; Schneider 1976). So, the specter of nuclear catastrophe now becomes synonymous with global climate change – *as cooling* – but in a new way. It is driven or led by a form of Earthly transformation that now appropriates previous nuclear discourses, so as to "precipitate a climatic catastrophe—a nuclear winter" (Weissbourd 1984, 8). Now, it is the climate *itself* that is affecting or fomenting the apocalypse; nuclear fire becomes the progenitor and *servant of* its larger and more engrossing nuclear winter.

It is important to note that this is certainly *not* to say that theories debating global climate change caused by CO_2 and greenhouse gas (GHG) emissions were unknown or not being discussed at this time. Articles as early as 1981 in prominent American journals such as *Foreign Affairs* very presciently pinpoint and discuss the dangers of a global warming from the burning of fossil fuels (see Kellogg and Schware 1981).

However, the important question that arises here is why, despite this link and portent of CO_2 and atmospheric global warming that we consider so obvious today, did climate change did not rise to prominence or command public attention until the end of the 1980s and early 1990s? Even *Bulletin* frequently joined the chorus of scholars and politicians debating over nuclear winter, claiming that "even a relatively small nuclear exchange might result in the extinction of the human species due to a factor earlier studies neglected to consider—the dense clouds of soil particles and the smoke from fires that would be generated by nuclear explosions" (Weissbourd 1984, 8).

Through the concept of nuclear winter, widespread fears of a truly catastrophic global climate change now became entrenched in public consciousness in the 1980s for the first time. Yet it was not CO_2 or global warming, but the cooling of a nuclear winter that underlay public concern. As Sagan's 1983 *Foreign Affairs* article states in its title, this was simply a combination of "Nuclear War and Climatic Catastrophe" (1983). The transition was made clear in the scientific community:

> Many meteorological investigations have been devoted to atmospheric transport and deposition of radioactive material from nuclear bomb testing. Very few studies have, however, been performed on the possible changes which would take place in the physics, chemistry and meteorology of the atmosphere as a consequence of a large nuclear war. (Crutzen et al. 1984, 323).[1]

Nuclear winter was not taken lightly by policymakers nor the public. It attracted enough attention to elicit scientific publications (see Ehrlich et al. 1983; Crutzen et al. 1984; Sagan 1985), debates in political science journals (Sagan 1983; Martin 1988), Hollywood films such as *The Day After* (1983), and TV documentaries such as *In Search of: The Coming Ice Age* (1977), which was narrated by Leonard Nimoy. Each of these spawned prolonged media attention, concern, and debate. Commenting on the

[1] In IR and the social sciences today, atmospheric geochemist Paul J. Crutzen is associated with inaugurating the Anthropocene epoch (see Crutzen and Stoermer 2000; Crutzen 2002). However, as this chapter illustrates, Crutzen's greatest achievement was perhaps not in developing the Anthropocene, but in the concept underlying both it *and* climate change as we know them today: nuclear winter (Crutzen and Birks 1982; Crutzen et al. 1984).

documentary film *The 8th Day* in 1985, the New York Times cautioned its readers that if a nuclear war occurred, even in the form of "a pre-emptive strike . . . the climatic changes would be devastating" (Corry 1985). Indeed, *Bulletin* authors concurred: a nuclear winter resulting from "a major nuclear war would threaten the entire world – not just the nations directly involved" (Malone 1985, 55).

On 20 November 1983, ABC News hosted a debate on nuclear winter on its popular program *Viewpoint* (1983), which included former Secretary of State Henry Kissinger, astronomer and author Carl Sagan, former Secretary of Defense Robert S. McNamara, author and political commentator William F. Buckley Jr., Lieutenant and General Brent Scowcroft, and philosopher and theologian, Elie Wisel. Their discussion even opened with an interview with then Secretary of State to President Ronald Regan, George Schultz (*Viewpoint* 1983). These distinguished panelists were assembled due to the enormous public response to the film *The Day After* (1983), a dramatic dystopian portrayal of the world after a nuclear war in which survivors faced a global climatic change in the form of nuclear winter. "The movie . . . became, in a sense, much more than a movie" claimed Koppell to his audience and the panelists as the debate began. "It became a national *event*" (*Viewpoint* 1983). This event was powerful enough to spur the US Senate and House to hold hearings on the threat of nuclear winter in 1984 and 1985, with the US congress even going as far as authorising the Defense Department to conduct "'a detailed review and assessment' of scientific findings on nuclear winter". As noted by Robock in 1989, this influx of funds dedicated to studying the climatic effects of nuclear holocaust "was virtually the only source of funding for university scientists . . . [creating] important spinoffs, expanding the ability to use climate models to investigate other problems" – such as, after the Cold War ended, the atmospheric workings of climate change (Robock 1989, 35; Edwards 2012).

Throughout the 1980s, there remains – from today's presentist/finalist vantage point – a strange overlap and entwining of nuclear and climatic discourses in *Bulletin* and elsewhere (see Masco 2010; 2016). For example, between 1987-1988 the UN compiled a report blending the two concepts together, in a "Study on the Climatic and Other

Global Effects of a Nuclear War" (Bergstrom et al., 1988). This report emphasised the familiar catastrophic narratives concerning nuclear war and its effects upon the globe, but now placed not nuclear winter, but simply "global climate change" at the forefront of the discussion. The report was initiated "Following the recognition by a number of scientists in 1982 that a major nuclear war might have grave climatic effects with global implications". Echoing the apocalyptic overtones present in the 'atomic fire' discourses since the 1940s, and reminiscent of Revelle and Suess's 1957 piece on CO_2 emissions, the report highlights that

> the planet on which we live exists in a fragile balance. For the first time in the history of the human race, humanity is now taking actions that, within the time-span of a single generation, are affecting the global environment in fundamental ways. . . The future implications of global warming and ozone depletion are just being fully recognized. (Bergstrom et al 1989: vi)

As Smith once wrote, "a discipline's silences are often its most significant feature. Silences are the loudest voices" (1995, 2). What emerges from this 1989 UN report is not that it isolates CO_2 or ozone depletion as its central focus of planetary threat, but that it is now silent about the importance of fallout and radiocarbon C-14.[1] In their stead are now concerns about *organic* carbon in the form of particulates released into the atmosphere as smoke and soot, through the incineration of forests and vegetation in nuclear fires. Despite further studies indicating that a nuclear winter would indeed occur in the event of a nuclear exchange, 'climate change' now slowly transitioned away from nuclear winter, and into the concept of a warming due to *carbonic* global climate change from other forms of organic carbon: namely, CO_2.

Writing shortly after this report in *Bulletin* in 1992, noted historian of science Spencer Weart combined nuclear war and atomic catastrophe with climate change in an article appropriately titled "From the Nuclear Frying Pan into the Global Fire" (1992). Weart

[1] There are two small mentions of carbon-14 on page 43 of the report, although they do not feature in the main body of the report, nor in its recommendations.

credited the recent global awareness of environmental threats – such as global warming and the greenhouse effect, which were now gaining prominent public attention from the first UN Framework Convention on Climate Change (UNFCCC) conference held at the Earth Summit in Rio in 1992 (see chapter 5) – as gaining momentum from the earlier public discourses surrounding nuclear war. "It was nuclear energy above all that changed ideas about humanity's role as an agent of catastrophic change", he noted (1992, 19). Atomic and nuclear scientists, as well as the *Bulletin* itself, were also given due: "These scientists (including those who founded the *Bulletin*) were the first to spread fears of total global disaster" (1992, 19). By 1992, we read how "The idea of global catastrophe as punishment for corruption had emerged again" (Weart 1992, 27). It now assumed the form of a catastrophic global warming – but this time, *without* any atomic fires or nuclear scaffolding needed to support it anymore. Climate change was now *carbonic*.

Notably, although correctly highlighting that global climate change depended on nuclear technologies and advanced GCM computer modeling, Weart maintained that nuclear and climatic catastrophe were fundamentally different ontological objects. Although Weart opens his 1992 *Bulletin* article by noting the irony of the year 1896, in which Swedish geochemist Svante Arrehenius's theory of CO_2-induced planetary warming was made concurrently with the French physicist Henri Becquerel's discovery of radioactivity, the article ends with a staunchly presentist claim: "Looking farther back, to the years since 1896," Weart writes, "if climate science had received even a tenth of the support that nuclear science received, our situation today would be different" (1992, 27). As this chapter has argued above, however, this is clearly not the case. Climate science, and the concept of a catastrophic global warming that Weart embraces from today's present conceptual perspective, emerged directly – and contingently, at multiple points – *from* the ongoing study and technological exploration of nuclear war and its planetary effects.

Climate change and science simply would not 'be' this way at all, if not for nuclear science, radiocarbon fallout of C-14, and nuclear winter. Hence, from the micro-politics

and atmospheric dynamics of the radioactive carbon atom, upwards to the planetary scope of apocalyptic annihilation, the scientific, political, and public awareness of climate change was not merely coterminous or parallel with nuclear war – it emerged directly *from* it.

Twenty years later in 2012, Paul Edwards retreads Weart's argument in *Bulletin.* In a similar fashion, he gives recognition to the important role of nuclear technologies and the computerised monitoring of radioactive bomb fallout, carbon-14, and even nuclear winter, as helping to awaken scientists and climatologists to global atmospheric processes now embraced in GCM climate models. And similar to Weart, Edwards notes that "Along with the discovery of the Antarctic ozone hole in 1985, nuclear winter brought the prospect of massive human-caused damage to the planetary atmosphere out of the realm of distant speculation and into the close-at-hand fears of the US public" (2012, 36). He also notes that nuclear weapons and climate models are "entangled", and that knowledge of each has been co-produced. "Today, the laboratories built to create the most fearsome arsenal in history are doing what they can to prevent another catastrophe—this one caused not by behemoth governments at war, but by billions of ordinary people living ordinary lives within an energy economy that we must now reinvent" (2012, 37). Yet, like Weart, Edwards' history separates the globality of nuclear and climate catastrophes as being explicitly different and distinct ontological objects, when the globality of the latter emerged through and from the former.

The Ghost of Lippman: Global Conduct, Global Concept

In Edward's 2012 *Bulletin* article, he comments on the state, its citizens, and global catastrophe, claiming that today's climatic disaster is caused "by billions of ordinary people living ordinary lives" (2012, 37). This brings us to an important and notable inversion from the discourses of global catastrophe proffered in *One World or None*.

In 1946, Lippman's was advocating for a form of world law that undercut national sovereignty by operating on the level of individual conduct and subjectivity. Today,

unlike the *Bulletin*'s tendency in the 1940s-60s to emphasise individual political action, there is indeed a return of the state as the primary, if not sole, actor on the international stage. Yet, what has happened to the individual or subject? Here, Lippman's comments are worth repeating:

> "For when an idea that enlists men's hopes is seen to be consistent with their acts, it evokes and organizes their energies. It is not then an abstraction or an essence. It is a dynamic force in their conduct. There are the ideas that shake the world and change it." (1946, 149)

Catastrophe was to be avoided, according to Lippman, by circumventing the security dilemmas plaguing collective security after World War II through a psychological and subjective "world state". Formal institutions were to be avoided. Instead, "the advance towards a wider and greater order of peace among men depends upon the same fundamental idea." Yet this idea operated not internationally, nor through states and their institutions, but *globally* by permeating and overriding national conceptions of sovereignty and working from below; through each subject, and then beyond them as individuals to a collective, through a shared form of conduct. This global "idea that shakes the world and changes it" does not mean international nor world unity, nor that all states and peoples "will become suddenly unanimous and incandescent with enthusiasm to found the world state" (Lippmann 1946, 130). Instead, Lippman's point is that a shared subjective idea will yield shared rationalities and actions, thereby raising the possibility – again, from the bottom-up, subjectively, and conceptually – of changing the potential for global catastrophe through a *conceptual* rather than (inter)national, unity.

What this chapter argues is that through the technological globalisation of the concept of anthropogenic global climate change, a form of *global conduct* – i.e. order, in the psychological or subjective sense described by Lippman – has been established at a subjective level. "Order", in this sense, is certainly not a form of order resembling an official world state or international organisation, but a pattern of conceptual activity (see Bull 1977). Order, here, is the implicit conceptual sharing of the idea of a global climate

that steers or governs the conduct of individuals, regardless of their nationality or state. As noted in chapter two, this "exercise of power [as] a 'conduct of conducts' and a management of possibilities" is indeed a form of governmentality (Foucault 2002, 341). And in the emergence of the global problematique of climate change from out of the complexity of nuclear technologies and physics, a new correlation of physics with government emerges – "a new type of global circulation in [world] governmental practice . . . this appearance of a new form of global rationality, of a new calculation on the scale of the world" (Foucault 2008, 56). It is a *global* governmentality.

Conclusion

This 'calculation' on the scale of the world began with nuclear technologies and fallout, but is now made through GCM technologies. As the practice of bringing this global climate into being, GCMs are the subject of the next chapter. With the end of the Cold War in the early 1990s, and the concomitant decline of fears of nuclear exchange, nuclear laboratories had to justify their continued existence by working on a new threat: "their many powerful supercomputers, their expertise in numerical modeling of fluid dynamics, and their skills in managing very large data sets" thus translated towards climate modeling (Edwards 2012). As this chapter illustrates, this move from nuclear to climate science and modeling was no coincidence: the global climate is not carbonic, but nuclear at its conceptual root. Global climate change is a direct product and descendent of global nuclear war. Tracing carbon and CO_2 today is thus an echo of tracing radionuclide fallout and atomic bomb particulates from mushroom clouds.

With the nuclear roots of our contemporary climatic problematique now identified, it is to a greater examination of *how* it is manifested and practiced technologically, that this project examines in the next chapter.

Chapter 4 – GCMs: Practicing Climatic Globality[1]

> Plurality is the condition of human action because we are all the same, that is, human, in such a way that nobody is ever the same as anyone else who ever lived, lives, or will live.
> (Arendt 1998, 8)

> Nothing short of action which affects every individual on this planet will forestall global catastrophe.
> (Tolba, M. Executive Director, UN Environment Programme. Quoted in Miller 2004, 46)

This chapter analyses the central practice underlying the problematique of climatic globality identified in chapter 3: computerised simulation models known as General Circulation Models (GCMs). It interprets how this practice shapes our everyday thought.

For climate scientists and modellers, GCMs are considered as the primary practice bringing the climate into being (Heymann 2010a). There is no such thing as a global climate without GCMs first modelling and constructing it as an object (Edwards 2010; Hulme 2009). As such, GCMs shape human thought and conduct through their simulations by producing the specific concept of a 'global climate' that becomes taken for granted by states and their citizens alike. Concepts thereby "provide analysts with an understanding of what is 'out there' and in doing so help to grasp relevant phenomena by naming and giving meaning to its features" (Berenskoetter 2017, 152). However, what has not been explored in terms of climatic globality is whether or not the specific concept of 'global climate' that is produced by a GCM is actually coextensive with, or amenable to, the other types of concepts and practices to which it is unquestioningly attached in IR.

[1] Sections of this chapter appeared previously in Hamilton, S. (2016). Action, Technology, and the Homogenisation of Place: Why Climate Change is Antithetical to Political Action. *Globalizations*, 13(1), pp. 62-77.

For instance, take the important concept of political action. It has become commonplace to hear that "serious action on climate change must start immediately to avoid grave risks, and [this] urgency for action increases . . . with each year of delay" (Dessler and Parson 2010, xii). Or, as former UN Secretary General Ban Ki-Moon so aptly phrased it, "The heat is on. We must act" (as quoted in Harvey, 2013). Yet, as noted in chapter 1, we have seen only collective action failures in response to climate change. Calls for a global reduction in CO_2 emissions have resulted in steady annual increases, and the more that GCMs and climate scientists call for "action" against looming global climatic catastrophe, the less action seems to be taken. Indeed, "there remain few problems that are as politically intractable" (Hulme 2014, p. x). Why this increasing political inaction, even when, "If inaction continues, the science tells us that the risks are huge—eventually the future of humanity and all of life as we know it are at stake" (Dryzek et al. 2013, 39)?

This chapter argues that the conditions for substantive or meaningful political action are contradictory to the concept of the 'global climate' that is produced by a GCM. It demonstrates this by comparing the philosophical and metaphysical foundations of GCM technologies with that of human social and political action. It finds that our concept of political action requires speech, debate, and a plurality of human actors to engage one another in social and unpredictable ways as public citizens (see Arendt 1998) – evincing "the freedom to act with plural others to bring something new [and unprecedented and unpredictable] into the world" (Owens 2009, 37). With political action defined as such, then the technological and mathematised concepts of Nature, climate, and world that are produced through GCMs are difficult to reconcile with the unpredictability needed for human action. In other words, the metaphysical underpinnings of the concepts of global climate, and political action, do not mesh together at a subjective or implicit level.

Interpreting the philosophical constitution of the concept of climatic globality also avoids adopting and repeating well-tread and presentist assumptions that IR and global governance discourses are now familiar with. These usually include a list of game-

theoretic or economistic collective action problems (see Held et al. 2011; Helm and Hepburn, 2009; Stern, 2007), the identification of statist greed as a "cancer of Westphalia" seeking zero-sum gains (Harris 2013), and multinational corporations obeying the market dictates of a neoliberal capitalism (Klein 2014). This chapter does not intend to discredit or disagree with these narratives, but it does argue that a deeper or more fundamental rationality facilitating these failures is at work: a technological metaphysics that brackets the unpredictability of human possibility within the calculative grids of a GCM.

This chapter now begins by elaborating more upon GCMs, focusing primarily on the physics and computational operations that grant them their explanatory power. It then reviews notions of social and political action as defined by Hannah Arendt, and contrasts them with Heidegger's concept of technological enframing. Then, by analysing how GCMs underpin the "infrastructural globalism" of sociotechnical systems standardising our common discourses of climate globality (Edwards 2010, 25), the chapter turns to the international authority and gatekeeper on the science of climate change: the Intergovernmental Panel on Climate Change (IPCC). The chapter concludes that the GCMs embraced and disseminated in venues such as the IPCC do indeed dispense a new type of "global cognitive framework" or global conceptual orthodoxy (Urry 2011), but that this framework it is one dependent upon what this thesis has identified as a subjectivist relationality.

GCMs: Placing the World in a Numerical Box

Generally speaking, climate models are not windows or mirrors into reality or Nature. They are analogues or approximations of the behavior of Nature, based upon mathematical hypotheses, projections, and a selection of specific variables and processes selected for analysis. Since it is impossible to conduct an actual experiment with the entire global climate, insights into its behavior can only be provided by experimenting with "digital climates", or *representations* of Nature. By adjusting levels of different climatic inputs and timescales (e.g. CO_2, methane, etc.), and their interrelations and

conditions on these computers, a CGM allows for the "extrapolating [of] past and future states into the future." A model is deemed "good", if its digital representations of Earth's natural processes – its output – match with observations of Earths and climates past. If a model matches with the past, therefore, there is a high probability its future projections will also be accurate (Gramelsberger and Feichter 2011, 2). In short, climate models grant insights into the future of the Earth's processes, and hence of global climate change, because they "allow experimental methods to be applied to phenomena which cannot be studied using traditional laboratory techniques" (Edwards 1999, 461).

According to the latest Working Group I report of the IPCC (2014), GCMs are the gold standard for understanding climate and Earth system changes today. "Climate models are the primary tools available for investigating the response of the climate system to various forcings [i.e. inputs affecting the climate, such as radiation, CO_2, etc.] for making climate predictions on seasonal to decadal time scales and for making projections of future climate over the coming century and beyond" (Flato et al. 2013, 746). According to the IPCC, GCMs are tasked with quantifying and mathematising the fundamental physical laws of Nature and the processes of the Earth system. This involves many steps, but can be summarised thusly: (1) "Expressing the system's physical laws in mathematical terms"; (2) "Building and implementing these mathematical expressions on a computer", requiring numerical methods for "discretized mathematical expressions, usually implemented on some form of grid such as latitude-longitude-height"; and finally, (3) "Building and implementing conceptual models" called "parameterizations" for smaller sub-grid-scale processes such as humidity, cloud formation and movement, and biogeochemical processes in vegetation, because these processes remain too complex to be quantified and resolved by the discretized model equations (Flato et al. 2013, 749).

As Edwards has described GCMs (2010 142), they reunified the three main strands of meteorology that remained separate prior to World War II due to a lack of statistical and computational power: forecasting, dynamical-theoretical meteorology, and empirical-statistical climatology. As noted in chapter 3's tracing of nuclear climates in *Bulletin,*

replacing the tediousness of hand-made calculations, the digital computations of GCMs became powerful enough to combine these three meteorological strands into a single research program. This transformed climatology "from a statistical science oriented toward the particularity of regional climates into a theoretical science focused more on the global scale." GCMs, in other words, not only *make* the climate, but they also grant it *globality*. They are what make it possible to calculate the immense complexity of planetary-wide atmospheric phenomena. So, how do GCMs actually manage this task?

The answer is through incredibly complex simulations of atmospheric fluid dynamics that are processed through supercomputers. The laws of physics dictate that the Earth must remain in a thermal equilibrium, despite being bathed "in a constant flood of solar energy" (Edwards 2010, 143). This means that climate modeling must begin with an "energy budget" detailing the relationship between incoming solar radiation and outgoing Earth radiation. Although many such models have been attempted, GCMs have succeeded in simulating not just radiative and heat exchange, but circulations and processes of the atmosphere that result from factors such as planetary rotation, gravitation, humidity, etc. (Edwards 2010).

There are two basic components to a GCM. First, its "dynamical core" simulates large-scale atmospheric and planetary movements using the primitive equations of fluid motion; second, its "model physics" must represent other atmospheric processes that are actually too small or complex to be modeled directly in the dynamical core. Hence, this latter function must "parameterize" these smaller processes and variables, which include the heat and moisture transfers of cloud formation and movement, or heat transfers between oceans, land, atmosphere, for example – as "sub-grid scale processes" (Edwards 2010, 146). As noted in chapter three, the first generation of GCMs began with a Cartesian grid-like structure, which continues today. Vertical and horizontal grid boxes (i.e. rectangles), approximately 100km x 500km in size, cover the entire planet's atmosphere. Then, rates of energy transfer occurring within each grid box, are calculated with varying inputs, timescales, etc.

In general, as generations of GCMs are coded and re-coded, and as mathematical complexities and access to supercomputers, data retention capabilities, and processing speeds increases, GCM simulations get faster to run whilst increasing their accuracy. These grid boxes get smaller and more precise as increased computer power makes grid resolution better (i.e. the grid boxes get smaller and smaller). Since the 1990s, not simply atmospheric, but other Earth processes and systems are able to be included in GCMs. For example, the atmosphere and ocean were combined into atmosphere-ocean general circulation models that are now standard in the IPCC (AOGCMs), and more recently, biogeochemical Earth systems (i.e. Earth system models, ESMs) and Integrated Assessment Models (IAMs) that include socioeconomic processes, are employed (see Edwards 1996 for more on the difference between ESMs and IAMs). These latter ESM and IAM models are used in studies of the Anthropocene, most recently underpinning the popular 'planetary boundaries model', which is explored (and critiqued) in chapter 6.

It is difficult to exaggerate not only the mathematical and physical complexity of these models, but also the rarity and the expense of the giant supercomputers required to operate them. Today, the dollar cost of a GCM stretches well into the millions. "No fields other than nuclear weapons research and high-energy physics have ever demanded so much calculating capacity" (Edwards 2010, 170). This has resulted in forms of scientific nationalism over the possession of these supercomputers, and a jealous oversight over the specific codes and formulas used and exchanged between different modeling groups and laboratories over decades. "Because of their complexity and expense," notes Edwards (1999, 445), "the total number of atmospheric GCMs is not large—probably around 50 worldwide", which results in each GCM actually sharing a "common heritage". As each group borrows models and codes from one another, quirks and mistakes of past models are passed down and developed within newer versions. As Edwards, the world's expert on the history and development of GCMs describes it, "Several modellers [*sic*] told me that substantial segments of the computer code in modern GCMs remain unchanged from the original models of the 1960s" (1999, 445). Indeed, there is a global epistemic and "transepistemic" community of climate scientists that now exists based upon modeling, replete with their own social norms and protocols

regarding model types, maths, physics, parameterization standards, model goals, etc., practiced within each model and group (Hulme 2010; Knorr-Cetina 1982). Yet the concept produced and shared by this epistemic community, the global climate, moves far beyond modelers and scientists into the minds and actions of "policymakers and other agents and institutions with compelling interests in global change issues" (Edwards 1996, 150).

The point here is that even in the realm of digital supercomputers producing the global climate and Earth system models – which disciplines such as IR take for granted as 'scientific' – there are social, historical, and subjective human dynamics in constant operation in the background. Aside from their mathematical fluid dynamics, GCMs cannot be reduced to objective equations of Nature and climate. Where there are people and practices, there, lurks politics. For instance, even selecting and calculating the sub-grid processes of parameterizations generates not only computational "data-friction" (i.e. disagreements or discrepancies between models), but personal and emotional vendettas between scientists and groups attached to their own model calculations and justifications for their parameterization selections (Sundberg 2007). These even become politicised in some cases, such as competing groups debating over whether model complexities such as "flux adjustment", a computational discrepancy that arises when grids of the atmosphere are coupled with the ocean, causing the "flux" of a drifting climate (Shackley et al. 1999), should be highlighted in policy recommendations.

However, this chapter does not aim to delve into the exact physical science of GCMs, nor the intricacies of their historical development through the state-funded militarism driving Cold War atmospheric sciences (see Hamblin 2013; Howe 2014; Fleming 2010). The science and history underlying international GCM developments and the rise of its global epistemic community of modellers, is so vast that it now occupies its own sub-discipline within geography and climatology (for a comprehensive overview, see Edwards 2010; 2011; 2012; Dahan Dalmedico 2001; Heymann 2010b. For a comprehensive account written by climate scientists, see the edited volume by Randall 2000). With such a large historical scope, this project is wary of launching into detailed

mathematical descriptions of atmospheric fluid dynamics (see Vallis 2006; Flato et al. 2013) or the history of the physics and rival supercomputer codes and groups fueling GCM development (see Donner et al. 2011; Lynch 2008). Instead, this chapter aims to elaborate an unexplored component of GCMs as they relate to globality and subjective conduct in our present moment: how the knowledge and concepts shaped *by* this computational practice governs the possibilities for political action.

But What of Nukes? What of Ozone?

Prior to exploring the link between the practice of GCMs, metaphysics, and political action, two potential issues regarding the argument set forth below must be briefly addressed. The first issue concerns the disappearance of discourses of GCMs and nuclear winter (see chapter 2); the second issue concerns the famous action taken to remedy the 'Ozone hole' that was taken by states through the 1987 Montreal protocol. If political actions were undertaken concerning these global crises, how does that affect the genealogical inquiry of this thesis, and the argument set forth in this chapter?

First, if GCMs likewise brought nuclear winter into conceptual being in the early 1980s (Crutzen and Birks, 1982; Turco et al., 1983; Robock 1984), then is nuclear catastrophe plagued by the same 'lack of action' as climate change? The answer is no, because the threat of nuclear winter is quite different. First, contrary to common belief, this threat has not subsided. In fact, it has intensified, but has been displaced in the public and political spotlight by its conceptual descendant: climate change (see Robock 2010).

Second, unlike global climate change, nuclear war is indeed more experiential or able to be comprehended without GCM models (i.e. we have seen videos of nuclear explosions; we have seen images of mushroom clouds; and most importantly, we know of the devastation, photos, videos, and have heard the devastating accounts from the survivors of Hiroshima and Nagasaki from the atom bomb detonations in 1945). Finally, whilst nuclear war was also attributed to state agency, climate change is made the responsibility of every single human individual. For instance, every breath exhaled

emits CO_2, thereby contributing to the 'globality' of climate change in ways not possible with nuclear winter.

Following from this, the 'hole' discovered in the Earth's ozone layer over Antarctica is also very different from the issue of global climatic change. First, and experientially, the ozone hole could be sensed directly by a human self: magazines and TV images carried visualisations, maps, and messages directly to the public, whilst the "immediate threat of increased skin cancers and other damage to people and biological systems shocked officials" and publics alike (Weart 2003, 153). Secondly, the average citizen "grasped the link between ozone loss and both Styrofoam and aerosol cans, causing a 50 percent drop in their sales even before legislation was enacted" (Ungar 2000, 303). It thus appeared to the average citizen that the ozone issue was easy to solve, and did not impact their own lifestyle substantially. Climate change, however, is not only considered to be more complex and multifaceted, but unlike the ozone hole, it cannot be tied to concrete events, locales, or metaphors that a public could rally around as a (w)hole (Ungar 2000). Finally, and importantly, the "state-firm relations" were entirely different in the case of ozone. As Falkner notes, the global chemical industry made the Montreal Protocol a success because it was easy and advantageous for corporations emitting chlorofluorocarbons (CFCs) to switch to other chemical compounds in their manufacturing processes. The producers of ozone-depleting substances (ODS) "entered into a global race to capture the emerging market for ODS technologies and products" (2005, 105), resolving the ozone issue in ways amenable to both logics of capital, and state-firm relations.

With nuclear winter and the ozone hole revealed to be of a different political and conceptual nature than global climatic change, this chapter will now move on to analyse the conceptual interaction of 'climate' and 'action'

The Action, Technology, and Metaphysics of GCMs

At first, the technical and digital forms of knowledge manifested through the practice of GCMs might appear to be outside of the scope of a genealogy. However, "the bestowing of authority on these scientific practices [GCMs] is the outcome of cultural processes, not of scientific research" (Heymann 2010a, 196). GCMs are authoritative *social* practices because they crystalise and disseminate a shared and specific concept of a global climate. This concept is shared across polities, and indeed, across cultures. Each time the concept of a 'global climate' is conjured, the knowledge disseminated from this practice is used. GCMs, in other words, create and sustain the climate within "systems of action *insofar as* they are inhabited by thought" (Foucault 2000c, 201).

GCMs accomplish this conceptual monopoly in two ways. First, they delimit and orient the boundaries and range of possible 'thought' concerning global climate change. Second, they steer the range of possible 'actions' – the "speaking, doing, or behaving" of knowing subjects – that are constituted upon this climatic thought. Here, for Foucault, action is defined as "the play of true and false, the acceptance and refusal of rules, the relation to oneself and others" (Foucault 2000c, 201). What GCMs produce, therefore, is not the climate, but a conceptual model *of* the climate. It is a way of thinking, that may or may not facilitate certain forms of action.

It is this conceptual model and way of thinking that becomes known and naturalised in public, academic, and IR discourses as our knowledge of global climate change. And it is this model, and the concept of climate it produces, that comes to be known and discussed as the climatic globality analysed in this thesis, and throughout academic and public discourses alike. Following Bartelson and his own account of the social construction of globality (2010, 220), because "the sociopolitical world is accessible to knowledge and intervention only by means of concepts", it is in analysing the social effect of this concept of climate from GCMs – rather than just its science, history, or epistemic communities –that new insights into its political conduct are granted. Hence, in order to respond to Szersynski and Urry's claim that "the social is central *and* pretty

well invisible" in IR's analyses of science and climate change (2010, 3, emphasis original), this chapter now analyses how the practice of GCMs frames the subjective potential for action.

An early attempt to examine the social effects of GCMs and the globality of climate science and knowledge was made by former climate scientist (now turned critical social scientist) Mike Hulme. He describes GCMs as producing "global kinds of knowledge [that] claim to offer the view from everywhere" (2010, 559). This knowledge asserts itself to be true and universal, regardless of time and place, because it is grounded in the complex physics and mathematics of GCMs. Here, for Hulme, the epistemology of climate becomes global because the science underlying it is, by definition, globally valid. Hence the obvious danger is that this global knowledge becomes hegemonic and imperial, erasing or obfuscating local or indigenous forms of knowledge derived from culture, traditions, language, myths, etc. The danger of the GCM is that it paves over local ways of knowing the world, with a homogenising and Westernised concept of climate. What is fostered is thereby "a consensual global knowledge which erases difference and allows the most powerful to determine what is 'known'" (Hulme 2010, 563. Also see Hulme 2009; Dahan 2010).

However, this interpretation borders on a subtle form of anti-universalism that has become fashionable in ecological and Anthropocene discourses in recent years (see Bruno Latour's similar argument in Salter and Walters 2015). Declaring this concept to be hegemonic simply *because* it is scientific, embodies the applicationism this thesis aims to avoid. Without delving into *how* this concept of climate is produced in the practice of GCMs, and thus how it structures thought, Hulme's account also risks succumbing to the same forms of scientism highlighted in IR by Jackson (2010). In a somewhat circular way, climate science is assumed to be hegemonic, simply because it is scientific, and vice-versa. But what about the other side of the coin, or what *underpins* this science, and its 'view from everywhere'?

Although sympathetic to debates concerning the partiality or "situatedness" of knowledge and epistemology (see Nightengale, 2003), one must adopt a different tact when considering the conceptual underpinning of this science: its metaphyscial and technological nature (see chapter 2). Interpreting the metaphysical grounds of technologies such as GCM simulations thus allows us to examine what this practice *does* to knowledge, subjectivity, and conduct, prior to the hegemonic effects claimed by Hulme.

We may begin by asking how this concept is materialised in a social and political world though human thought and conduct, in celebrated ideals and concepts such as 'global mean temperature'. Indeed, a global treaty firmly entrenching limits to the global mean temperature by limiting the CO_2 emissions of states was a primary goal of the COP21 conference noted in chapter 1. Hulme lambastes this concept as "psychologically sterile" because no one actually *experiences* the global average temperature in their everyday or specific locality. Indeed, the "most commonly cited figure in climate change debates—change in the average global temperature—has no correlate in anyone's actual living conditions" (Edwards 2001, 33).

Yet, what Hulme ignores here is how the social and inter-subjective function and construction of 'global mean temperature' is not dependent upon its materiality or concrete reality. Rather, here it helps to remember what Foucault advised when studying or thinking of the social and political effects of "power". Like the concept of global mean temperature,

> there is no such entity as power, . . . global, massive, or diffused; concentrated or distributed. Power exists only as exercised by some on others, only when it is put into action, even though, of course, it is inscribed in a field of sparse available possibilities underpinned by permanent structures. (Foucault 2002a, 340).

What matters when considering power is not its materiality, nor the reality of the physical structures through which it collects or flows, nor even the psychological

constructs it engrains within objects or institutions. Instead, Foucault's point is that power – like global mean temperature, or the concept of the climate itself – must be approached by asking what, and how, it affects the subjectivities and relations of (inter)acting humans. The key is to gauge action, the "acting upon one or more acting subjects by virtue of their being capable of action. A set of actions upon other actions" (2002a, 341). In other words, one way to grasp the social impact of the globality of GCMs is to interpret their effect as practices upon individual and collective forms of action. In other words, do not look for the materiality of a global mean temperature out there in the world; interpret how this concept inscribes itself into forms of action, or in the case of climate change, *inaction*.

In order to detect how GCMs shape concepts of climatic globality through (in)action, we must first define what 'action' is. As noted in chapter 2, it is here where Arendt's philosophy acts as a bridge between Heidegger's technological metaphysics, and the formation of subjectivity and conduct along Foucauldian lines. Arendt, in other words, is a philosopher of the social, technology, and of action, *par excellence*. By studying the changing historical manifestations of action, Arendt was thus able to read into how the implicit relations of technology to subjectivity structured explicit human sociopolitical understandings of the world (Yaqoob 2014).

Arendt's understanding of technology and action cannot be isolated from her positing of a "human condition" comprised of a tripartite division of labour, work, and action (1998; 2006). There is no such thing as a universal human nature within this framework. Rather, there is only the endlessly transforming social and historical orientation of these three components of the human being, that "condition" its thought, world, and subjectivity. Through this social conditioning, the nature of the *vita activa* or active life lived amongst other humans, is likewise established. Just as humans alter and hence condition their world, so they are in turn conditioned by it (1998, 9).

Whilst human *labour* takes care of the eternal recurrence of our biological life cycles and its processes (e.g. hunger, sexual desire, etc.), it is *work*, or the fabrication,

construction, and transformation of the raw materials of Nature, that constructs a human *world*: the buildings, dwellings, statues, monuments, temples, etc., around which a human social and cultural public meets, interacts, and engages in politics. It is the fabrication of this world that distills a contiguous sense of human time and memory across a culture and its peoples over generations. In this world, plural human interaction and dialogue takes place, making it possible for a *political*, and not simply a natural or animalistic relation and experience, to appear. Thus, it is in only in this shared world that *action* can occur.

To act is to embrace the unpredictability of human inter-action from one's unique place in this shared world: a direct engagement and discourse with others, which begins "to set something in motion . . . [so that] something new is started which cannot be expected from whatever may have happened before" (1998, 177). Hence, political action, "the only activity that goes on directly between men without the intermediary of things or matter", by "correspond[ing] to the human condition of plurality, to the fact that men, not Man, live on the earth and inhabit the world" (1998, 7), is intimately tied to each person having their own distinct place through which to engage their world and each other: "because we are all the same, that is, human, in such a way that nobody is ever the same as anyone else who ever lived, lives, or will live" (Arendt 1998, 8).

Political action – the starting of something new and unpredictable whilst working and debating with other plural agents in a shared world – thereby manifests such unique historical events as the founding of a state, the initiation of a revolution, or the creation and implementation of a new political constitution. Its essence mirrors what Arendt calls *natality*: "the new beginning inherent in birth . . . because the newcomer possesses the capacity of beginning something anew, that is, of acting" (1998, 9).

What is important to note here is how the unpredictable process, end, and effect of action cannot be predetermined or predicted at the outset or origin of a political engagement. One cannot, therefore, experiment with action. "The fact that man is capable of action means that the unexpected can be expected from him, that he is able to

perform what is infinitely improbable. And this again is possible only because each man is unique, so that with each birth [of a child, a state, or even a conversation in a political space,] something uniquely new comes into the world" (1998, 178). Human reality and its history are thus disclosed through this ongoing dialogue between acting humans and the making of unexpected events in a shared world. It is this world, created through work but made political through speech and debate, where mere 'objective things' found in a space of appearance can bind humans together in ways hitherto unthought nor even experienced prior to this worldly action (1998, 182). A pen and paper, for example, can be far mightier than a sword, if they produce a constitution that brings a new state or form of politics into the world.

This brings us to the topic of *in*-action concerning climate change. If its looming threat of catastrophe signals that clear and urgent political action must now be undertaken to avert disaster, then why has this Arendtian ideal of political action proven to be so absent or ineffective? If the IPCC has clearly "confirmed that humans are destroying the earth's climate", revealing that "Twenty-five years of human effort to protect the climate have failed even to slow that destruction down" (Brecher 2015, 1), why has no action been effective in ameliorating this crisis?

The answer to this question lies in the *concept* of 'global climate' that is produced by GCMs. As complex computer simulations of Nature, recall that the essence of GCMs is also what Heidegger describes as the essence of modern Western subjectivist metaphysics, "the setting-upon that challenges forth the energies of nature", yet only to further some other task or goal (1977a, 15): 'enframing' (*Ge-stell*). Enframing is the implicit and technological manner in which subjectivity reveals Being as comprised of extensible objects to be measured and related to the subject. It occurs through the "gathering together of that setting-upon which sets upon man, i.e., challenges him forth, to reveal the real, in the mode of ordering, as standing reserve [i.e. as calculable, orderable, and as objective]" (1977a, p. 20). Enframing describes the way that we as subjects relate to objects in our world, and its essence is made tangible or crystalised in complex digital technologies such as GCMs. Here, as in any digital technology, objects

must be translated into digital codes that can be understood or discretely 'encoded' by the computer. By "cutting up the world in this manner", every referent "is transformed from the continuous flow of our everyday reality into a grid of numbers that can be stored as a representation of reality which can then be manipulated by algorithms" (Berry 2011, 2). To be placed inside the numerical grid of the GCM, Nature and Being must first be enframed.

Following from Arendt's notion of the 'human condition' above, if the essence of climate change is conditioned in, through, and by the digitised atmospheric fluid dynamics of GCMs, then we are presented with two immediate discrepancies between these concepts. They arise because of the mathematical essence of the concept of climate in a GCM's form of metaphysical enframing, and the way human beings must think and enact this 'enframed' concept in a human and political world. Readers should also keep in mind the arguments set forth here as this thesis advances, as they remain in the background of each chapter's arguments, and come to the fore once again in chapter 8 regarding the use of 'quantum entanglement' in security discourses.

First, let us examine the conversion of this concept into human speech and dialogue, which is required for public deliberation and discourse to lead to action. For Arendt, speech is what makes a human *political.* But, "the sciences today have been forced to adopt a 'language' of mathematical symbols which, . . . now contain statements that in no way can be translated back into speech" (1998, 4). We can make sense of a concept, and convey knowledge about it to others, when it can be spoken and thought about between human subjects. However, the catch here is that speaking of 'climate change action' cannot be political in this sense. The concept of 'climate' *itself* is an agglomeration of computerised mathematical symbols that cannot be rendered thinkable without being translated and then communicated through experts, such as the IPCC. "[P]eople remain utterly dependent on experts for evaluating the global circulation models on which the whole game is predicated", notes Ungar (2000, 297). "As Stephen Schneider put it, climate change mainly exists in the silicon chips of supercomputers." As such, GCMs model a concept that can (a) never be experienced, but results only from

computational synthesis, and (b) is never directly felt or known through human senses, even by the academics and publics tasked with knowing and acting upon it. Global climate change is thus experientially vacuous, despite its increasingly urgent political implications.

In other words, the concept of 'climate' is actually an analogue of the GCM model *itself*. GCMs actually model the data, codes, and inputs from *other* models, and thus study themselves, rather than any actual 'real' climate – for there is no real climate, other than what is now produced by the GCM model. To even think and speak of climate change today, therefore, is now to model it, albeit implicitly, within our own thought and discourse. And as this section has argued, at its conceptual root, this is a mental or subjective analogue model that is a model of a GCM's climate, that is so complex in its basic formulation and calculation that it can never be fully conveyed to a human being's understanding or speech.

Second, the capacity for natality or unpredictability that is required for something new and unexpected to emerge in action, is also dissolved in this concept of climatic globality. As noted above, the codes and algorithms of GCM supercomputers depend upon the rigour of complex physics and mathematics. "Modern physics is the herald of enframing", wrote Heidegger (1977a, 22). "For already in physics the challenging gathering-together holds sway . . . It is challenged forth by the rule of Enframing, which demands that nature be orderable as standing-reserve" (1977a 22, 23). Presciently, Heidegger notes that causality in physics will become a "reporting challenged forth—of standing reserves that must be guaranteed either simultaneously or in sequence" (1977a, 23). In other words, humanity's grasp of Nature will rendered as a sequence of orderable relations between objects and a subject(ivity). Indeed, although Heidegger and Arendt were writing before 'climate change' became a tangible political concept or debate, both do note quantum physics as becoming illustrative of humanity's tacit subjectivism (see chapter 8).

The point here is that Arendt concurred with Heidegger, noting that, as concepts are projected mathematically as "general laws of behavior . . . endlessly reproducible repetitions of the same model" (Arendt 1998, 8), then the fundamental grounds for human action dissolves into grid-like patterns of "normalization" (1998, 40). Normalisation, from Foucault, to Arendt, to Heidegger, is fundamentally contradictory to unique and unpredictable action. This raises the question of whether the GCM's concept of climate facilitates normalisation. "The [GCM] models help us create a public space," claims Edwards (2001, 54), "including shared knowledge, shared values, and access to common tools and data, for consensus building on global change issues." Indeed, the formation of this 'public' will be explored below through the case of the IPCC. For now, however, it is clear that any public space or so-called 'world' in which climate action must occur, is one constructed primarily through GCM technologies. A public's knowledge of climate remains one bounded and delimited by GCMs. Hence, the unpredictability of natality that is manifested in human speech and politics cannot occur if there is no *human* speech, but only the digitised computations underlying this mental model of Nature (i.e. climate). In other words, this is a public with an implicit conceptual model of a climate operating as akin to a Cartesian grid, when 'action' requires a transversal movement; something akin to "a 'polygon' or, rather, 'polyhedron' of intelligibility, the number of whose faces is not given in advance and can never properly be taken as finite" (Foucault 2002d, 227). Therefore, the production of mathematical concepts through GCM practices – if they now form the grounds for politics, culture, and everyday thought that many now claim (Hulme, 2014) – thereby appears *antithetical* to the form of human speech, subjectivity, and interactive conduct that is required for effective or meaningful political action to occur.

For example, let us recall that the largest component of climate modelling is "parameterization" – i.e. subsuming and 'tuning' endless sub-scale grid processes such as clouds, vegetation, and *even human social and political interaction*, under coefficients and algorithms of larger-scale grid processes (Edwards 2001, 57). Here, GCMs produce concepts of climate in which human action is *already* pre-packaged, quantified, and bounded within the model as calculative variable or mode of ordering.

Indeed, recent Earth System Models (ESMs) and Integrated Assessment Models (ISMs) treat humanity as follows: "due to lack of quantitative understanding of the social system most models reduce the social system to economic modelling assuming rational decision making" (Verburg et al. 2016, 331). In other words, in the most advanced models and supercomputers we possess, the 'human' condition within the GCM – and the *vita activa* – is always *already* that of the enframed and rational 'economic man'. For Villa, this "metaphysical rationality" sublimates action "by the rational securing of first principles and the positing of ends in accordance with these principles" (1996, 160-161).

If political action emerges from the confluence of unique individuals and their *particular and distinct* place in a world, and if the enframing underlying the physics of GCMs demarcates and delimits *uniform and homogenous* metaphysical boundaries of thought – expressed in predictable, mathematical, and predetermined modes of calculative thinking – then human action and GCM knowledge are implicitly antithetical. Any potential for unpredictable action will be squashed before it can begin, if thought is pre-ordered, and regulated within a GCM simulation's "solidarity of procedure and attitude with respect to the objectification of whatever is" (Heidegger, 1977b, 126). Once nature has become enframed and revealed only as a "report" of itself, "that is identifiable through calculation . . . , [and] orderable as a system of information" (Heidegger 1977a, 23), then any distinct and unique spaces of appearance, places, and things, will thus become concealed by the uniformity of mathematical calculation.

What remains to be explored is how the practice of GCMs and its enframed concept of climatic globality might be shared amongst states and citizens more generally. Hence, this chapter concludes by turning more directly to modes of international relations and climate governance that disseminate this form of knowledge and conduct throughout societies and nation-states of the world: the IPCC. If the IPCC is indeed "one of the most striking globally networked entities in the modern world, [which] increasingly insists upon the *certainty* of climate science and of global warming," (Urry 2011, 24,

emphasis original), then how might the distribution and adoption of GCMs and their concept of 'climate change' frame globality for states and the their citizens?

The IPCC: GCMs and Calculating a Global Epistemology

The IPCC was officially formed in 1988 under the auspices of the UN Environment Programme and the World Meteorological Organization (WMO), in response to a growing international awareness and concern over a possible global warming. Today, it is the international benchmark for the science and governance of climate change. It establishes how states and citizens can enact policies to adapt to its effects, and what mitigation efforts should be pursued in the future so as to soften these effects.

According to Hajer (2009, 16), the function and purpose of the IPCC is historically unique and *sui generis* in global politics. It is "a remarkable achievement", "the most complex 'science for policy' vehicle to be created to date, not only bringing together the academic disciplines needed to understand global warming, but speaking and reporting to the 113 governments that were [originally] involved in the UN climate-change initiative". Today, this stands at 195 countries, and comprises thousands of scientists from around the world. As stated by its former IPCC Chair Rajendra Pachauri, the IPCC is "that [which] makes it possible for policymakers to accept the science in a very simple way. As a result, therefore, . . . [it] provides a roadmap on the basis of which policymakers can take action, and deal with the challenge of climate change" (Pachauri, 2014). Indeed, the IPCC is frequently referred to as the global mapmaker, whilst policymakers (and citizens) are to 'navigate' global and local action through the map the IPCC draws.

IR textbooks are replete with descriptions of the IPCC as a new and unparalleled type of international institution. For example, general IR accounts view it as "a new way of conducting detailed communications between core science and government policymakers" (Manning 2011, 32), whilst more critical scholars view it as a "hybrid

science-policy assembly that has played an enourmously powerful role of 'ontological kind-making' around climate change . . . a powerful oligopticon . . . and its *scale* of worldwide mobilization of scientific expertise for politics is unprecedented in history" (Blok 2014, 51).

Rather than provide a general overview of its history (see Bolin 2010), review its role as an international governance institution and norm producer (see Miller 2007), or critique its function as a disciplinary pan- or 'olig-opticon', the remainder of this chapter focuses on the spread of concepts and knowledge emanating from the IPCC. In other words, the issue here is how the IPCC disseminates a concept of climate change to states that may have "globalized the atmosphere by constructing a discourse" framing climate change and globality (Miller 2004, 47). The question is whether or not the metaphysically-enframed concept of climate noted outlined – a concept that is both subjectivist, and antithetical to political action – is spread by the IPCC.

The credibility of the science of the IPCC is established through global research networks, premised upon shared methodologies and strategies aimed at producing coeval or synchronous forms of data. It is a coextensive and global utilization of GCMs that ensures that "it is *models*, rather than data, that are global. . . . The dynamics of the earth's atmosphere could not be understood without them—at least not at a level of detail that would confer the ability to make long-term projections" (Edwards 2001, 60). If each of the 195 participating countries – and their scientists – had different notions of what the climate was, or what GCMs were modeling (and how), then not only would the IPCC break down, but the concept of 'global climate change' itself would fracture as well (see chapter 5). Hence, the IPCC's globally uniform methodology as a conceptual Trojan horse.

At first glance, this corresponds with Hulme's account of the universalising and homogenising tendencies of climatic knowledge. Norms such as global mean temperature decreed by institutions such as the IPCC establish a fulcrum around which each state must conduct itself, and its citizens. This could open the way "for

managerialism on a planetary scale" (Hulme 2010, 559, 561). However, what this chapter has also argued is that we must be careful when declaring pro- or anti-universalist stances concerning climate change and global knowledge. Concepts of globality must be analysed by considering their subjective formation, or how they affect human thought from the bottom-up when they are enacted. Declaring science to be managerial still risks embracing a top-down framework that ignores the potential for human action and creativity to emerge in unknown or unpredictable ways. For example, Arendt argues that natality itself – the possibility for action – is a shared condition of humanity. Therefore, if we are to proclaim that the "universality of the human race in nature doesn't work. Something else has to be done before we talk about the common world again. . . . we have to do some new work which looks – I agree, provisionally – as divisive" (Latour, quoted in Salter and Walters 2016, 544), we risk substituting for the framework of science or politics, an equally structural framework of particularism or ecologism.

Therefore, the point of this chapter is not to engage in a war of frameworks, but to conceptualise what thinking of the concept of 'the climate' does on a metaphysical and subjective scale, as an enframed object in relation to a subject. IR has made some brief inroads in this direction. For example, Paterson and Stripple (2010) have traced how climate change produces a governmentality of an individual's own "carbon conduct" as their personal "My Space" in which subjects practice low-carbon diets, manage their carbon footprint, calculate their daily emissions, and organise their everyday micro-practices around CO_2 emissions. This approach illustrates the making of individual subjectivities responsible for their own practices, yet in direct relation to the 'global' threat of climate change delimited by the IPCC.

On an international level, Mahony and Hulme have traced the spread and dissemination of specific climate models to argue that their use in developing countries is tied to a "global praxis" in which citizens, scientists, and publics, oriented their own behavior around IPCC-approved models. This has fostered an "an epistemic harmonisation by which the networks of climate science and politics, with their attendant practices,

discourses and expectations, are extended and strengthened in global space" (Mahony and Hulme 2012, 207). In sum, even though it is local knowledge that is the input and output of these models, they ultimately operate and facilitate the "epistemic landscape" of the IPCC, "ever-present as a legitimating, custodial and aspirational force" (2012, 208). There is indeed a complex interplay of particularism and universalism at work. GCMs, therefore, not only function as a model of climatic globality, but as a practice of how humans can think, interact, and model themselves in relation to Nature and their social surroundings (Andersen and Neumann 2013).

Conclusion

This chapter has analysed the practice underpinning the problematique of climate change and the Anthropocene today: GCM simulations. It explored how GCMs construct the globality of climate, and how the concept of climate they produce is enacted politically in international arenas such as the IPCC.

Rather than approach failures and inactions surrounding climate change by questioning economic or sociopolitical institutions, it instead applied the concept of 'action' to the concept of 'climate' emerging from GCMs. This revealed how, on a metaphysical level, the enframed notion of a calculative global climate is antithetical to the fluidity and unpredictability required for human political action. These two concepts do not mix.

Therefore, general and critical perspectives in IR and the social sciences fail to grasp the depoliticising nature of GCMs because they have not yet considered this conceptual and metaphysical foundation. Instead, they tend to assert or substitute new and top-down frameworks of anti-universalism for science, or vice-versa. As argued in this chapter, however, anti-universalism also risks replacing one form of technological enframing for another.

This chapter has also responded to calls that IR has been absent in climate change discourses, despite the fact that "the argument of the science itself is that human

practices are utterly central to this particular global risk" (Szerszynski and Urry 2010, 3). In doing so, it has also pointed towards questions that Heymann put towards social scientists:

> "We may have to ask how the physical scales of global climate modeling relate to the social scales of local human action and interaction. Identical modeling methodology is disseminated and used all over the world, while varying alternative knowledge traditions lose authority. How did climate modeling succeed in creating something like a unified world picture of climate?" (Heymann 2010a, 196).

This chapter and this thesis project answers this question by highlighting how this 'world picture' is not an experiential object, nor a universalising type of managerialism. Rather, it is a technological and metaphysical form of subjectivity. It is channeled and crystalised in technologies and practices such as GCMs. Rephrasing the statement of Pachauri and the IPCC: when considering how GCMs draw their conceptual map of climate change, the forms of conduct they construct leads ultimately inwards to subjectivity not outwards to the Earth or upwards to the atmosphere. This fostering of a calculating human subject is then able to relate itself to the concept of a climate, as an object to be measured.

In calculating this global object, it is a subjective picture of the world that is drawn. Acting meaningfully and effectively within this world, therefore, becomes always circumscribed by the boundaries of this world picture before any action can begin. Placing climatic globality within this predictable grid thereby undercuts the political action required to move beyond its limits in unpredictable ways.

Chapter 5 – A Rationality of Powerlessness: Why the Global Climate Has *Always* Been Broken[1]

> In short, there is a problem of the regime, the politics of the scientific statement. . . . [and] of how and why at certain moments that regime undergoes a global modification.
> (Foucault 2002c, 114)

> What we are doing now is killing this [climate governance] process. The signal we are giving the outside world when millions are watching will be: 'We failed. The UN system failed'.
> Delegate at UNFCCC Climate Negotiations, Copenhagen Denmark, 2009 (quoted in Dimitrov 2010, 21)

Introduction

This chapter interprets the rationality underlying the practice of GCMs and the problematique of climatic globality in IR and climate governance. It argues that our everyday concepts of climate change and the Anthropocene are rendered thinkable through what it identifies as 'a rationality of powerlessness'. This rationality is a way of thinking in which the global climate is conceptualised as something always *already* damaged and broken, resulting from failures of international governance to steward the Earth. In other words, from its emergence in international relations in the late-1980s until today, the global climate has only and always been conceived in social science disciplines such as IR as something congenitally broken, that humanity is powerless to fix. This raises the question of whether it is possible to reconceive climatic globality in new ways, or to govern it 'successfully', when its conceptual core is composed of failure itself.

[1] Sections of this chapter have been published in Hamilton, S. (2015). The Global Climate Has Always Been Broken: Failures of Climate Governance as Global Governmentality. *Caucasus International*, 5(2)., pp. 141-161.

This argument is made by problematising international conferences and events that have become elemental to mainstream discourses of climate governance in IR today: the 1972 Stockholm Declaration, the 1979 World Climate Conference, the 1988 Toronto Conference on the Changing Atmosphere, and the Villach-Bellagio Workshops that led to the formation of the IPCC in 1988. It is indeed common to read that each of these conferences or events was of crucial significance to a steady and consistent rise of climate regimes and norms into the international policy arena (see Brenton 1994; Vogler 1996; Rowlands and Greene 1992). In other words, it is assumed that each conference was a stepping-stone towards a greater awareness of global climate change and humanity's impact on Earth's natural systems.

However, focusing upon the primary texts of these conferences through a genealogical lens, this chapter reveals a very different historical trajectory concerning how the 'global climate' came into being and became a topic of (international) conversation. Rather than concerns about safeguarding Nature or guarding against climate change, these conferences expressed fears and insecurities concerning humanity's scientific ability to control Nature as a harnessed resource. What was once a secure and sovereign climatic object located within each state's borders, slowly became a shared source of international political insecurity in the late-1980s. This was coupled with the dawning realisation amongst policymakers that technology would not prove to be the panacea they had hoped for, as it would not be able to solve emerging international crises of climate, agriculture, nor environmental depletion, as had previously been assumed. Indeed, the World Commission on Environment and Development's *Our Common Future* illustrates this trend (see WCED 1987).

Yet, *never* was the object of 'climate' first understood as a normal, robust, natural, or undamaged global referent. Rather, from what was previously a concept of the sovereign climate of each state, the globality of a new climatic object emerged only when states integrated and coordinated GCMs globally, in venues such as the IPCC, through the emergent rationality of powerlessness identified here. A global climate could only be formed once an agreed-upon and uniform methodology could be shared amongst states,

now able to monitor and track this climatic object's newfound global scope, and its concomitant failure or malfunction. From its outset, therefore, the global climate emerged in international relations and climate governance as something *always already* broken. It thereby came to embody the rationality of powerlessness and insecurity that helped to crystalise it, as states realised they could no longer exploit Nature as an infinite resource, but were now helpless to movements of Earth's geophysical processes and cycles.

This chapter begins by reviewing arguments that institutions and regimes of international climate governance have failed. It then analyses primary texts from the international conferences noted above, paying close attention to subtle transformations in their underlying rationality, whilst indicating obvious inconsistencies with IR's taken for granted historical narratives. The chapter then concludes by interpreting how this rationality of powerlessness was disseminated internationally through the IPCC.

Climatic Globality: Failure, High Politics, Ontology

This section analyses two common threads that tie discourses of climatic globality together today. First, the increasingly urgent failure(s) of international climate governance, and its resultant ascension into canons of 'high politics' in IR. Second, the notion that the climate is inherently (and ontologically) global in nature and scope.[1]

A rationality is a mode or style of thought. It renders concepts and certain aspects of reality thinkable and operable in social and material practices, and forms of calculation or technology (Miller and Rose 2008, 16). In the case of IR, we may ask: what is the rationality underlying global climate change and its international governance today? As

[1] Although theories and histories of climate governance in IR are frequently framed in a neoliberal discussion of 'regimes' (e.g. the rules, norms, and procedures inscribed in the IPCC or UNFCCC), or a more inclusive 'bottom-up' consideration of other non-nation-state actors (NNSAs) upon governance processes, these theories will not be considered in depth here (for a detailed critical overview, see Orereke et al. 2009; Paterson 1996). Rather, in its genealogical approach this chapter takes the referents of 'failure' and globality, and passes these through the grid of international conferences as practices, so as to interpret what emerges.

noted in chapters 1 and 4, discourses of climate politics are saturated by lamentations over governance failures, political inaction, and the inevitability of pending catastrophes (see Aradau and van Munster 2011). "Put simply," notes Paul Harris (2013, 2), from the Kyoto Protocol of 1997 and its attempt to regulate carbon emissions, to the Copenhagen Accord of 2009, "with too few exceptions, the politics of climate change, despite being increasingly energetic, has failed." Or, to take another common plaint: "The failure to generate a sound and effective framework for managing global climate change is one of the most serious indications of the challenges facing the international order" (Held and Hervey 2011, 96; Held et al. 2011, 5). Indeed, in IR, there exists a shared way of thinking about climate politics as an endemic failure; an impossibly daunting task. In other words, at "the level of global governance there has so far been a failure to generate a sound and effective international framework for managing global climate change" (Held et al. 2011, 7). Although its historical emergence will be traced below, this rationality can be identified here as a rationality of powerlessness. In it, always does the climate appear broken or damaged; always does governance seem to fail; and always, therefore, do we as human subjects feel powerless in relation to it.

This powerlessness raises the question of when and how failures of governance first emerged, and hence, how they can be fixed in the future. Although ripe with talk of failure, literature in IR today typically frames the development of climate politics and governance as one of a steady linear progression and development. Generally put, the 'climate change issue' developed from a disinterested or secondary type of 'low politics' in a world occupied with Cold War power politics, into a 'high politics' equal in respect and stature today to security, war, or diplomacy (Dalby 2014). Whilst environmental politics was first popularised with Rachel Carson's 1964 publication of *Silent Spring* (see Carson 2002), the climate problem took longer to emerge, and is typically framed as a recent occurrence, hitting "the international political agenda in 1988" (Paterson 1996). As mentioned in chapter 3, for example, even Richard Falk's landmark book *The Endangered Planet* (1972) contained not a single reference to climate change in all of its 494 pages.

Yet in the 1990s, with the recent establishment of the IPCC, a multitude of international conferences such as the 1992 Rio Earth Summit, and agreements signed by states regarding CO_2 and chlorofluorocarbon emission limits through the UNFCCC, it appeared to IR scholars that, finally, "the momentum had built up sufficiently to lead to international negotiations [and] an international convention on the subject" of climate (Paterson 1996, 61). It appeared as though a new awareness of this problem and a drive to fix it was indeed fueling a new and global reach.

Looking back, much like today, climate change is framed throughout the 1990s as an issue gaining importance and prominence in IR and the social sciences, always verging on high politics. Also writing in 1996, Vogler (1996, 1) noted how the "recent spate of interest" in climate politics was a direct reaction to political events such as the end of the Cold War (1996, 9), and he identified common events such as the 1987 Montreal Protocol's 'Ozone Diplomacy', a greater attention to biodiversity issues, and the emergence of climate change governance in the 1980s and at specific UN summits such as the Rio Earth Summit in 1992, as evidence that climate had now become a "high politics" issue. Even today, no IR account is ever complete without noting the testimony of NASA scientist James Hansen to the US Senate in 1988: it was "time to stop waffling so much and say the evidence is pretty strong that the greenhouse effect is here'" (Hansen, quoted in Brenton 1994, 166). For IR scholars, "This statement attracted widespread attention and illuminated the importance of the issue" (Rowlands 1992, 30). At this time, Vogler also highlights a voice typically omitted from IR literature today: the "Most prescient" voice regarding climate change, he noted, "was John von Neumann, the co-founder of game theory" (1996, 2. See chapter three for von Neumann's role in monitoring nuclear fallout and creating the GCM). Vogler quotes von Neumann's prophetic claim made in 1955, the year prior to his death, that "human intervention would deeply affect the atmosphere's general circulation . . . All this will merge each nation's affairs with those of every other, more thoroughly than the threat of nuclear war or any other war may have already done" (von Neumann, quoted in Vogler 1996, 4). Yet, von Neumann was a physicist, not a diplomat nor a politician. Hence,

even into the 1980s, climate change had not yet become an international nor a global issue.

What was it that allowed climate change to ascend to the realm of high politics in the 1990s, answering the call von Neumann made back in 1955? It is indeed generally accepted that the concept went from being a "technical specialism peripheral to [IR's] interests" in the 1970s and 1980s, to embracing a "paradigmatic shift" between the 1972 Stockholm Conference and Rio's 1992 Earth Summit. "Simply stated, it involved the shift to a *global* rather than a purely localised or transboundary phenomena" (Vogler 1996, 5). Vogler, for example, notes the shift to globality in the 1990s, but does not provide a reason for how it could have emerged. He asserts that "the projected climate change associated with the enhanced 'greenhouse effect' [has] a truly global scope" and therefore it fosters "extraordinary interconnection between the issues involved . . . from even a cursory examination." With the 1990 release of the first IPCC report on the science of global warming, and the 1992 Earth Summit and creation of the UNFCCC following shortly thereafter, it seemed that global climate change was a problem now well on its way to being resolved. "It was, therefore, no longer possible to *pigeonhole* environmental issues in International Relations as a narrow technical specialism" (Vogler 1996, 7, emphasis original).

Today, this buoyant mood has shifted drastically. After noted failures of climate governance in such events as the 1997 Kyoto Protocol, the 2009 COP15 in Copenhagen, and the recent COP21 in Paris (see chapter one), we might assume that this optimism towards climate change ascending into the realm of high politics, had waned. For instance, as Brecher writes (2015, 59), climate protection and its politics have clearly failed: "What went wrong? Why has the world's obvious long-term common interest been so hard to realize?" Rather than optimism, however, today it is precisely this notion of failure and insecurity that fuels increasing calls for the ascension of climate change into high politics. Its existence as a global problem that so clearly transcends the borders of sovereign states, and threatens international relations with systemic collapse, has elicits claims that "climate change has ascended to the realm of high politics"

(Carter 2013, 177; Dalby 2014). Indeed, even the self-declaredly critical manifesto of planet politics adopts this rationality of climatic failure as indicative of its increasingly deserved prominence in IR: "Now that ecological catastrophe is unquestionably the gravest security challenge to face this planet, why has IR failed to take on a new, corresponding vocation?", the authors ask (Burke et al. 2015). "We contend that International Relations has failed because the planet does not match and cannot clearly be seen by its institutional and disciplinary frameworks" (2015, 501).

In short, the more effort and attention that has been given to the governance of the climate, the more these efforts have failed, and the more damaged the climate becomes, thereby demanding even more effort and attention. At first, this appears to be a repetitious cycle or a vicious circle, that should easily be resolved by better and more effective governance. However – and as will be explored below – what if the concept of this broken global climate is something that, at its foundational and conceptual core, cannot be fixed? Will this make our current governance strategies and policies a Sisyphean endeavour?

With its notions of 'failure' and demands for climate politics to ascend into high politics now outlined, this section now moves on to its second section: from the epistemology of climate governance, to its ontology. This concerns what the global climatic object in need of governance actually 'is'.

Even in critical IR, the mainstream histories of climate governance outlined above are generally taken for granted. They simply assume that the climate is a universally and naturally 'global' object. For example, governmentality scholars such as Methmann (2013) similarly assert that "climate politics takes place in a genuinely global polity", because it is "first and foremost visualized as a global problem . . . which constructs global warming as an inherently global field of visibility" (2013, 77). He cites the Clean Development Mechanism (CDM), an emissions reduction scheme that was included in the failed Kyoto Protocol, as a "perfect example of a genuinely global governmentality" because "sovereignty and governmentality" can be "situated in a liberal economy of

power, governing 'at a distance'"(Methmann 2013, 71).[1] Due to the inherent planetary scope of this object, he therefore asserts, "If there has been such a thing as a governmentality of climate protection, it has been a *global* governmentality" (2013, 77).

This assumption of the climate as inherently 'global' is endemic to IR's literature. In a similar fashion, Luke argues that a "green governmentality" must inherently be global, because "the time-space compression of postmodern living has brought the bio-power of the entire planet, not merely that of human beings, under the strategic ambit of state power" (Luke 1999, 122). Oels (2005, 198) similarly argues that "planetary management on the basis of biopower grounds itself in the natural sciences to model the complex workings of the biosphere", thereby obscuring local action by working through the natural globality of the atmosphere. Again, what ties these examples together is twofold: first, the notion that the climate is and has always been, global; and secondly, that the concepts used to examine the successes or failures of climate governance must be epistemologically and ontologically distinct *from* this sense of globality. It is taken for granted that the climate is both damaged and global, and thus that it can be governed so as to be fixed.

A Rationality of Powerlessness: How our Global Climate emerged as Broken

This chapter will now problematise these axiomatic assumptions concerning the universality of globality and failure in climate governance. In genealogical fashion, it aims to "pass these universals through the grid" of international conferences *as* practices (Foucault 2008, 3).

As chapters three and four of this thesis illustrated through the development of nuclear discourses and the practice of GCM simulations, it was not simply climate governance,

[1] Notably, Methmann does highlight here how the failure of the CDM does not imply the failure of governmentality itself, because "the failure of CDM allows carbon governmentality to fulfill its actual function": orienting conduct. However, Methmann still succumbs to two fallacies here: First, that of liberal applicationism, as outlined in chapter 2. Second – and most importantly for this chapter – he makes the ontological and epistemological assumption that liberal markets and their entrenchment through CDM failure, remain ontologically and epistemologically *separate from* the globality of the climate as a 'natural' global object.

but the climate *itself* that became global in the 1980s. Indeed, the very first international conference on climate change, 'The First World Climate Conference', was held by the World Meteorological Organisation (WMO) only as recently as February, 1979.

When looking at primary texts rather than recent and secondary historical accounts, it becomes evident that even as recently as 1941, the concept of a 'global climate' was limited only to small scientific and military communities. Notions of climatic globality were virtually nonexistent within larger overall discourses of states and regimes of international governance. Outside of the scientific community of climate modellers, each state considered their sovereign climate as a *resource* at their own disposal. For instance, take the US Department of Agriculture in 1941: "The distinction between climate and weather is more or less artificial, since the climate of a place is merely a build-up all the weather from day to day and the weather is merely a day-by-day break down of the climate" (Hambidge 1941, 4; Miller 2004). The U.S. Weather Bureau likewise considered the climate as a sovereign "natural resource . . . part of the natural endowment of a country", and hence it was "axiomatic" that "the outdoor climate cannot be changed, except on the smallest scale . . . [and in] contrast to mineral resources, climate is inexhaustible" (Landsberg 1946, 293).

In 1966, the U.S. National Research Council (NRC) stressed that, despite possible alterations in CO_2 levels creating regional climatic changes, in the past these only "had locally catastrophic effects, [and] they did not stop the steady evolution of civilization" (NRC 1966). Statist ontologies of climate, therefore, were previously considered as localized, regional, and bounded objects, akin to other natural resources, and thus primed for economic exploitation within each state's sovereign borders.[1] Yet, the question concerning this chapter is not how nation-states came to think of the climate as a resource, but how this sovereign resource became linked-up and conjoined to a global (atmospheric) object of governance.

[1] This chapter will not aim to repeat the history of local and regional ontologies of climate and the state, which have been covered in detailed analyses of US archival sources by historians of science and climate. See Fleming 1998; Weart, 2003; Stevens, 1999; Miller, 2004; Hamblin 2013. Rather than rehasing these secondary accounts, this chapter examines genealogically how the concept of climatic globality developed through the primary texts of international conferences.

We begin by analysing the text of what is now considered to be the foundational moment for climate governance today: the 1972 UN Conference on the Human Environment (UNCHE), in Stockholm. This is touted as one "of the biggest international environmental events that have ever taken place", and thus, according to IR's conventional wisdom, "provides an excellent snapshot of the state of global environmental attitudes at the time it took place" (Brenton 1994, 12, 13; Rowlands 1995, 70). Today, it is indeed common to read that "In terms of formal international politics, the first UN Conference on the Human Environment (UNCHE) held at Stockholm in 1972 was a landmark . . . the starting point" for the activity of the United Nations Environment Programme (UNEP) and for climate politics writ large (Vogler 1996, 4-5). It also catalysed and "recommended more climate change research" than anything before it (Boehmer-Christiansen 1996, 179).

However, upon inspecting the actual texts of this event, the 1972 Stockholm Conference's final "Declaration" of "26 Principles" reveals absolutely no mention of climate change (see UNCHE 1972a; 1972b). Instead of safeguarding Nature or protecting the planet, the 26 Principles of the 1972 Declaration instead focus explicitly on "the human environment", aiming to make the world aware that "a stage has been reached when, through the rapid acceleration of science and technology, man has acquired the power to transform his environment in countless ways and on an unprecedented scale." The focus is more on protecting humanity, than Nature.

Hence, because "Of all things in the world, people are the most precious", it is the capacity of the Earth to provide resources for the benefit of "all mankind", that is the overarching concern of the 1972 Conference. As one section declares: "The Conference [is] launching a new liberation movement to free men from the threat of their thralldom to environmental perils of their own making" (UNCHE 1972b, 34). Its goal, therefore, was not as IR scholars frame it today – i.e. to assert how "Global environmental protection has been on the international political agenda since the 1972 UN Conference on the Human Environment" (Biermann et al. 2012, 51; Brenton 1994, 44-46). Quite to

the contrary, the intent of the 1972 conference was also to conquer and control Nature, not to steward it.

Climate change is indeed mentioned in the 1972 Stockholm conference, however.[1] It appears in the conference's 'Recommendation 79', a section on pollutants. Yet this small mention merely advocated further study of "the causes of climatic changes [and] whether these causes are natural or the result of man's activities" (UNCHE 1972a, 12). It did not refer to a global climate, nor did it caution policymakers about anthropogenic climate change. Instead, it referred to the many local and regional "climatic zones" (1972a, 20-21) that should facilitate cooperation between nations sharing similar, but ultimately disparate, climates (1972a, 26).

Instead of protecting the planet, therefore, the dominant style of thought or rationality underlying the 1972 Stockholm Declaration was one of securing "mankind's" technological control and use of the "resources" of Nature at "his" disposal. This was not stewardship, but a rationality of *control* over Nature. It is therefore ironic that the magazine of the UN itself, *The UN Chronicle*, today proudly proclaims that at the 1972 Stockholm Conference, "the Declaration raised the issue of climate change for the first time, warning Governments to be mindful of activities that could lead to climate change and evaluate the likelihood and magnitude of climatic effects" (Jackson 2007, online). Upon analysing the actual 1972 Declaration and its 26 principles, however, nothing resembling this common contemporary narrative is found.

Although there were smatterings of scientific gatherings in the 1970s, no official international conference between state leaders or officials on the topic of climate change took place until the 1979 First World Climate Conference in Geneva, Switzerland. Again, we read contemporary IR texts lauding this conference as the first international governance event to warn of the increasing concentrations of CO_2 in the atmosphere, claiming it represented "a slight hardening of the scientific view [that] gave rise to

[1] In other words, although discussion the mention of global climate change was primarily limited to technical papers between scientists, it did make a small mention here. See SCEP's (1970) 'Man's Impact on the Global Environment', for the views of the scientific and climate modeling community at this time.

further rounds of international scientific work" (Brenton 1994, 165). However, although climate change is now indeed an issue of the 1979 conference, and although the atmospheric science of climate is framed as global (White 1979, 6), its *political* conceptualisation is still not regarded as being global in scope, nor is it even primarily considered as anthropogenic or human-induced (WMO 1979). Instead, the Conference continues the well-established practice of treating state climates primarily as many disparate, local, regional, and inter-national spaces: "All countries of the world are vulnerable to climatic variations, . . . The climates of the countries of the world are interdependent", the Declaration reads at its outset (WMO 1979, 3).

As highlighted in the keynote speech by Conference Chairman Robert M. White, who was on the Climate Research Board of the US National Academy of Sciences, the impetus of the conference was still not to safeguard the Earth, nor to prevent pending climatic catastrophe. Instead, and following from the rationality of control undergirding 1972 Stockholm Declaration, the goal of the 1979 conference was to learn how to better harness national and regional climates as *resources* for economic development and exploitation. "We must therefore begin to think of climate itself as a resource to be allocated wisely", White stressed in his keynote speech (1979, 5), "contribut[ing] to a bright future for mankind by national and international actions to provide for the wide use of climatic resources to improve the economic and environmental welfare of people everywhere" (1979, 2). At this point, therefore, regional or national climate change remained the political norm for state and international politics. Globality was still relegated to the scientific realm.

Although CO_2 concentrations and dangers of a "greenhouse effect" were indeed discussed by White and others (for example, see Fedorov 1979, 15), the majority of the 1979 Conference and its proceedings focused primarily on economic productivity, food supply and population levels, and recommendations for states to use and exploit their own sovereign climate for a more effective economic development within their own borders.

Tasked with summarising the overall report, one of the final chapters – entitled 'Climate and Economic Activity' (d'Arge 1979) – even began by suggesting the possibility of, and benefits of, a "global cooling effect" rather than a warming (1979, 652-653). D'Arge then highlighted how knowledge of any global cooling or warming remained inconclusive: "direct scientific evidence of global climatic change induced by emission of CO_2, NO_x, and other by-products of industrial activities is not yet obtainable" (1979, 654); that global cooling would be "costly to society" but "global heating may be economically beneficial or harmful" (1979, 654, emphasis original); and notably, that this "extreme uncertainty" and "indecision on actual climatic changes induced by man" should lead the first conclusion on "global public policy" to be: "No large-scale controls affecting human society should be considered for at least 10 years. There is just not enough evidence yet" (d'Arge 1979, 655). Indeed, although CO_2 warming is contrasted alongside a possible NO_x cooling, d'Arge concludes that "If his [Nordhaus's] estimates are correct, then carbon dioxide can be viewed as a relatively manageable potential pollutant where immediate controls need not be considered" (1979, 680). What is immediately notable about the 1979 World Climate Conference, therefore, is that it is hardly the clear-cut beacon or initiation of anthropogenic CO_2 warming and active climate stewardship, that narratives in IR readily take for granted today.

A subtle but pronounced shift in thinking between the 1972 and 1979 Conferences may also be detected. By 1979, although the economic and regional focus on sovereign climates remained, the political rationality underpinning this focus was no longer the retention and promotion of humanity's control over Nature. Instead, it now transformed into an increasing awareness, and fear, that despite rapid advances in technology, humanity's control over Nature was illusory. A newfound appreciation that "not only is humanity vulnerable to variations in climate, but climate is also vulnerable to the acts of humanity. . . . It is a vulnerability that can only increase because the underlying causes will intensify, not diminish", is palpable in its texts (White 1979,3).

This emergent sense of uncertainty, unpredictability, and instability, is present throughout the proceedings of the 1979 Conference. "What is new," White stressed in

his keynote, "is the realization that vulnerability of human society to climatic events has not disappeared with technological development" (1979, 3). And alongside this realisation, the notion of transnational "man-induced climatic changes" enters international governance as a "new world condition" of climate vulnerability. Presaging the Anthropocene, it is hazarded and heralded for the coming millennium as "the ending of one era in the relation of humanity to the planet and the beginning of another" (1979, 4). Now, the interconnectedness of nations to their own climate, *and* to the "world climate", is crucial: "The importance of climate, recognized in these Conferences, suggests that the time is at hand to view world affairs through a climatic prism" (1979, 5). And it is a prism of climatic globality imbricated with humanity's vulnerability and insecurity in the face of an unpredictable Nature; what is identified here as *a rationality of powerlessness*.

As this rationality of powerlessness emerges, it is important to note that it is not excised from, nor does it transform, some neutral or scientific discourse that had previously established a fully-functioning, normal, or healthy world climate. Rather, it emerges *from its outset* through a rationality framed at its root by vulnerability, fear, uncertainty, and within the portent and prospects of the failure of human society to develop and to sustain the agricultural and economic resources required for its survival. From this style of thinking grows the fledgling notion that there is something larger in scope than the parceled, individual, sovereign economic climates previously commonplace and commonsensical within states and discourses of international governance prior to 1979.[1] Now, states – and not only climate modellers and atmospheric physicists in the scientific community (see SCEP 1970) – must consider the ramifications of 'world climate change', and the new process of seeing the world through a climatic prism.

As these notions of a 'global' climate governance take hold in the 1980s, the rationality of powerlessness (and the concomitant fear of a nuclear winter discussed in chapter 3)

[1] It should be noted that 1979 was also a watershed year for 'global' events that would have intersected with the First World Climate Conference, such as the so-called 'second oil and energy crisis' in the US resulting from the Iranian revolution reducing exports of oil; the election of Margaret Thatcher in the United Kingdom; the Three Mile Island nuclear accident on 28 March 1979.

shape its background, and become normalised. For instance, the opening statement of the summary of the 1988 Toronto Conference, the 'World Conference on The Changing Atmosphere: Implications for Global Security' (WMO and UN 1988) harkens back to the Revelle and Suess paper on radionuclide tracing and CO_2 uptake in the oceans (see chapter 3), but it now couples their conclusions with this new feeling of powerlessness: "Humanity is conducting an unintended, uncontrolled, globally pervasive experiment whose ultimate consequences could be second only to a global nuclear war", the new opening statement reads. "These changes represent a major threat to international security and are already having harmful consequences over many parts of the globe" (WMO and UNEP 1988, 292). The comparison between conferences in 1972, 1979, and 1988, thus exchange human control over Nature, for a climatic globality in dire need of repair. States must now "take specific actions to reduce the impending crisis . . . No country can tackle this problem in isolation" (1988, 292). And here, the paradox with which we in IR are familiar with today, crystallizes: "the more we become aware of the level of the threat posed by anthropogenic climate change, the less we seem capable of acting to prevent it" (Held et al. 2011, 1).

Methodological Unity makes Climatic Globality

Naturally, these past references to 'sovereign climates' and using a state's 'climate as a resource' sound strange and foreign to us today. They are easily omitted from present literature as irrelevant, outdated, or eccentric. Yet, to analyze and interpret such empirics and texts is the point of connecting genealogy to (global) governmentality: to trace how our modern and tacit political rationalities, which conduct our conduct at the subjective level, first emerged into being. It is thus important here – as this chapter outlines the *rationality* underpinning climatic globality – to remember that in 1979, the First World Climate Conference was "considered as the most profound and comprehensive review of climate and of climate change in relation to mankind yet published" (Foreword 1979, viii). It was, in other words, what diplomats and scientists concerned about global climate governance were thinking at the time.

Despite this cutting-edge comprehensiveness, however, this "profound" 1979 Conference admitted that its findings concerning climate change were not yet global in scope. Why? "At present," the Conference concludes, "new applications [and] methodology is largely being developed on an ad hoc limited national 'needs' basis. This leads to redundance and the development of products that do not necessarily make use of the best methodology" (1979, 23). The problem was that each state was using its own distinct concepts, methodologies, and knowledges, to delineate what each bounded sovereign climate 'was'. This led to incommensurable ontologies and epistemologies of this object at the international level; what Edwards (2010) called the "data friction" of GCMs.

This problem was well known to climate modellers, who wrote in 1970's SCEP 'Assessment and Recommendation for Action' that "the development of new methods for gathering and compiling global economic and statistical information" must be accompanied by "uniform data-collection standards to ensure, for example, that industrial data collection across the world will be of comparable precision and focus" (SCEP 1970, 7). Scientists were aware, long before states, that a truly 'global' climate required a global methodology and model data. However, scientists had to wait for a moment when international relations would be amenable to this requirement. Integrating and coordinating this much data was an extremely complex affair, demanding the oversight of an international institution of some kind.

It was in the mid-1980s that states realised that in order to govern a global climatic object, they all required the shared knowledge of a climate that was commensurable across borders. In other words, to possess a shared ontology of a global climate, they required shared GCM technologies to foster a shared epistemology. Indeed, "Programmes must be set up to assist [states] to participate fully in the World Climate Programme through training and the transfer of appropriate methodologies", declared the 1979 conference, requiring "an inter-disciplinary effort of unprecedented scope at the national and international levels" (WMO 1979, 6).

The 1987 Villach-Bellagio workshops are touted as the moment when the demand for a uniform science of climate change spurred politicians into action (Brenton 1994, 165). The text of the 1987 workshop introduces new aspects of 'political' discourse into what was previously the scientific realm of GCMs. In certain sections, it even adopts the disciplinary jargon of (American) political science: regional climate change is warned to be, "not a zero-sum game. Unless action is taken, it could be a negative sum game of highly uncertain proportions" (Jaeger 1988, 35). The report does stress, however, that unnecessary burdens are placed on separate international GCM communities. "Much of the scientific research that is required because of remaining uncertainties about climatic change will be organized nationally and carried out at individual institutions", resulting in data friction, and thus demanding:

> a considerable increase in global monitoring activities and the further development of climate models to improve our understanding of and to reduce uncertainties about the extent of *regional and global climatic changes* and their impacts on the environment and major socio-economic sectors. (Jaeger 1988, 39-40, emphasis added)

This was a recognition that moving *regional* governance to *global governance*, therefore, required uniform GCMs.

This "international effort" at methodological homogenization was finally established in 1988 in the IPCC (see Miller 2004. Also, see chapter 4), allowing the previously disparate regional and sovereign understandings of climate to adopt and share the global concept first trumpeted to states at the 1979 World Climate Conference. As Edwards writes (2010, 8), the "scientific expertise, technological systems, political influence, economic interests, mass media, and cultural reception" of global climate change, finally became concretized in 1988 in the "global knowledge infrastructure" of the IPCC.

What this chapter illustrates, however, is the rationality underpinning this moment: the concept of a global climate congealed into being within the shared GCMs of the IPCC,

but not as a neutral or objective scientific fact. It emerged as a global object only conceptualised *as* broken, and in need of governance to stave off congenital failure.

With the IPCC's formation, we find in its first Overview Report of 1990 the agreement that its "measures . . . require a high degree of international co-operation with due respect for national sovereignty of states", and yet "the convention should recognize climate change as a common concern of mankind and, at a minimum, contain general principles and obligations" to gain *adherence* of the largest possible number of states (IPCC 1990a, 60). Here, when compared with 1972, there remains none of the explicit claims and desires for 'mankind' to control and exploit regional climates for agricultural and resource gains. Rather, its science must shape "the appropriate strategy for response and action regarding the issue of climate change. . . . what is potentially the greatest global environmental challenge facing mankind" (Houghton 1990, vi). This not only concretizes the rationality of powerlessness undergirding the concept of global climate, but makes this same concept dependent upon ongoing internationalism and collaboration: "climate change would affect, either directly or indirectly, almost every sector of society, [and so a] broad global understanding of the issue will facilitate the adoption and implementation of such response options . . . [meaning that] Further efforts to achieve such global understanding are urgently needed" (IPCC 1990a, 60).

Today, this planetary normalization of a global climate and its governance operates through standards easily detectable by governmentality's toolkit (see the volume by Bulkeley and Stripple 2014): for many scholars, these include a standardizing global average temperature; the policing, regulating, economization, and calculating of carbon at individual, state, and global scales; and the marketization of the climate itself, as Methmann (2013) and Oels (2005) have described above. As Oels astutely observed, "the IPCC may thus be understood as the administrative space created by governments where they expanded their biopolitical mission of using and optimizing the forces and capacities of 'life' to the entire 'planet'" (2005, 198).

What this chapter has illustrated is how the *rationality* underpinning these arguments, and the IPCC's politics and discourse of global climate change, has disseminated this concept. Its mode of thought *depends on* powerlessness, vulnerability, failure, and an implicit understanding that a pristine Nature has been broken by humanity. The concept of global climate change was *made by* failure.

Today, this rationality underpins not only climate change, but the Anthropocene as well. We are told, in a manner reminiscent of the 1979 First Climate Conference, that there is a "reversal" of the relationship between climate and humanity. This time around, however, it is not Nature dominating humanity anymore. Now, "The Anthropocene means that the deterministic arguments about climate shaping human destiny are no longer relevant to the geopolitics of the twenty first century" (Dalby 2013, 45). "In the Anthropocene, some neutral, pre-given planetary nature is no longer available as a fiction of the real. We fucked it up" (Wark 2015, 169). Although the explicit discourse has indeed changed, globality in the Anthropocene thereby remains underpinned by the concept of climatic globality that emerged as broken, through a humanity powerless to repair it. The transition of climatic globality from climate change, to its incorporation into the Anthropocene, will be made in the next chapter.

Conclusion

This chapter has continued the genealogical analysis of climatic globality undertaken in this thesis. Grounded upon a nuclear problematique, and the practice of GCM simulations, it detailed how the late-1980s saw the formation of the IPCC, and the emergence of a 'global climate' within institutions and discourses of governance. The chapter argued that this concept of a global climate was rendered thinkable through a new and implicit rationality of powerlessness. This is a way of thinking and cognising the global climate only *as* a congenital problem, needing to be fixed and overcome. This also raised the Sisyphean question of whether it is possible to fix, heal, or correct the damage done to a concept that, at its core, is always *already* broken. The common claim that "Climate change is a global issue that requires global response. . . . [It] is a classic

global commons problem" (Xinyuan 2010, 622-623), is found, therefore, to be supported by the same failures it aims to avoid.

When IR's histories mention the testimony of James Hansen to the US senate in 1988, two relevant facts of his testimony are typically omitted. First, Hansen was not simply a NASA scientist, but he was a climate modeller. Second, President Bush's response to Hansen is overlooked, but it is particularly apposite for the argument of this chapter: "Those who think we're powerless to do anything about the 'greenhouse effect' are forgetting about the 'White House effect'" Bush proudly proclaimed. "'In my first year in office, I will convene a global conference on the environment at the White House . . . We will talk about global warming . . . And we will act" (NYT 1989). Yet, as this chapter has argued, the concept of the 'greenhouse effect' was itself comprised *of* powerlessness. When it comes to the globality of climate change, therefore, every explicit failure –from levels of the self, to regimes of global governance and COP21 – justifies its continued existence and elaboration, whilst also demanding and eliciting further conducts and behaviors oriented by this shared concept. It is therefore a global government, steering thought and subjectivity by, and through, failure.

Chapter 6 – The Anthropocene's Emergence: A Global Biopolitics of Carbon[1]

"…disturbing the climate inevitably means disturbing all components of the Earth system."
(C. Hamilton 2015, 34)

"Take away our ability to shape the environment, and human civilization becomes meaningless. A degree of control over the environment is what distinguishes civilizations from hunter-gatherer societies, and we clearly cannot afford to let it go".
(Friedrichs 2013, 172)

After the concept of anthropogenic global climate change entered the geopolitical arena in the late 1980s, its spread spurred a transformation in both the natural and the social sciences. This thesis has thus far interpreted the conceptual preparation of, and foundation for, this transformation in our current understanding of globality: its underlying nuclear problematique (chapter 3); its practice of conceptualising Nature through computer simulations (chapter 4); and the rationality of powerlessness and congenital failure rendering it thinkable (chapter 5). This chapter explores the concept that recently emerged from the overlapping of this problem, practice, and rationality of climatic globality: *the Anthropocene*.

At the turn of the millennium, climate science and policy had "turned the physics of the atmosphere and ocean into a multifaceted picture of the Earth system" (Feichter and Gramelsberger 2011, 8). The concept of global climate change had reframed the world as a single nexus or locale for integrated and interwoven human activity. From this new picture, the notion that "Earth as a whole is responsive to this planet-scaled social system" gained new resonance and appeal (Clark 2016, 129). Or, as phrased in

[1] Sections of this chapter appeared in Hamilton, S. (2016). The measure of all things? The Anthropocene as a global biopolitics of carbon. *European Journal of International Relations* (online: DOI: 10.1177/1354066116683831)., pp. 1-25.

discourses of IR, in the 1990s climate change became "a production problem in the making of a new world" (Dalby 2013, 38), a world where "humanity is literally making its future, not protecting a given context" or background of sovereign state systems, unaffected by global or transnational problems (2013, 46). In the year 2000, rather than only climate change, humanity was thus making *all* of Nature itself.

Scientists and physicists sounded the alarm. They proclaimed that "'business-as-usual' cannot continue. We are passing into a new phase of human experience and entering a new world that will be qualitatively and quantitatively different from the one we have known" (Steffen et al. 2011, 756). Indeed, "humanity has become a geophysical force on par with the earth-shattering asteroids and planet-cloaking volcanoes that defined past eras" (Vince 2014, 5). "Earth is now a human planet."

Today, therefore, it is common to read that IR must rethink its foundational categories and definitions, reconceptualising how the political, the social, the ecological, and the international, constitutes this "relatively recent" social fact of an entwined human-planetary globality (van Munster and Sylvest 2016, 4). Scholars now declare that, "At its most basic, this means that our fundamental image of the world must be revolutionised. Our existence is neither international nor global, but planetary" (Burke et al. 2016, 504). This supposed transformation into a new world of human mastery is captured by a slogan now common in IR and the social sciences: "Welcome to the Anthropocene!" (Dalby 2013b, 5; Economist 2011).

First outlined by atmospheric chemist Paul Crutzen and Eugene F. Stoermer in 2000 (Crutzen and Stoermer 2000; Crutzen 2002), the Anthropocene has since fostered boisterous debates amongst natural and social scientists alike (see Galaz 2015). The concept describes a geologic epoch that is so transformed by humanity's impact on the Earth's natural systems that it is stratigraphically distinct from the previous 11,700 years of its stable Holocene precursor. This means that humanity has forever etched itself in stone and ice within sediments of the Earth (Barry and Maslin 2016). However, this chapter aims to problematize the common claim that, in this Anthropocene epoch, the

human species is a geophysical force so masterful that it can 'make' Nature and "choose the future of our planet" (Vince, 2014). Instead, it argues that the Anthropocene is not a human-made epoch at all. Interpreting the Anthropocene genealogically, it emerges from the past problematiques, practices, and rationalities of climate change to constitute a new and global form of biopolitics. It governs humans implicitly through the calculation and politicization of the essence of all life: *the carbon atom*.

Declarations that humanity 'makes' Nature in the Anthropocene, therefore, illustrate an anthropocentric subjectivism that goes to the heart of this thesis. Upon inspection, claims that humanity has become a "force of nature" or the most integral component of the Earth system – "the reality that human action and Earth dynamics have converged and can no longer be seen as belonging to distinct incommensurable domains" (C. Hamilton et al. 2015, 3) – are here problematised. It is argued that they delimit and structure thought so as to privilege the human subject over all else, by conceptualizing and inserting carbon – the essence of all life, *and* the human – at every spatial and temporal scale, ranging from the atomic to the global, and from the transitory human lifespan and world, to Nature's geologic epochs. Ultimately, in the subjectivism of the Anthropocene, Nature is humanized and becomes mortal. Seeing carbon everywhere, the human also projects and sees itself.

What emerges from this anthropocentric gaze is an implicit political rationality. As outlined in chapter two, it is a new form of global governmentality. It moves beyond the scope of liberal or statist modes of governmentality, by coupling the carbon atom and the human self to the physics of ESS models and computer simulations. This new physics thus correlates with what this chapter calls 'relationality', or a technological metaphysics in which all beings and referents are cognized through an endless and ongoing carbonic relation to *anthropos*, the human being. Hence the 'illusion' in the Anthropocene that, as Heidegger presciently phrased it (1977a, 27), 'It seems as though man everywhere and always encounters only himself.' Indeed, claims that "We are the first to knowingly reshape the living earth's biology and chemistry. We have become the masters of our planet and integral to the destiny of life on Earth" (Vince 2014, 7) do not

illustrate actual planetary stewardship, nor humility. Rather, they belie a subjectivist relationality, grounded upon a biopolitics of carbon. As the Anthropocene emerged in 2000 as the apex of previous climatic globalities, it simultaneously positioned the human subject as the maker and measure of all things.

This argument will be made in three steps. First, this chapter will review how the Anthropocene is used in IR, outlining the new forms of Earth system governance and planetary politics presently being theorised in response to it. Although scholars differ greatly in their recommendations, the Anthropocene itself is generally taken for granted as the anticipated, inevitable, or future-reality of international and global politics. A thorough or sustained critique of this concept is thus warranted.

Secondly, this chapter explores how these discourses claim to 'make' Nature in the Anthropocene, using the philosophies of Arendt and Foucault. Interpreting the technologies and physics of the Anthropocene using Arendt's tripartite 'human condition' and Foucault's concept of biopolitics, reveals how new forms of thought and conduct grounded upon the carbon atom have emerged in Anthropocene discourses.

Third, it explores how the incorporation of carbon within GCMs in fields of nuclear and climate science ultimately facilitated today's rise of today's Earth system science (ESS) and the Anthropocene. Integrating these steps, this chapter concludes by linking the philosophical foundations of Arendtian and Foucauldian biopolitics, with the planetary and technological metaphysics of Heidegger. Doing so reveals the Anthropocene as a global biopolitics of carbon, in which the human self is always *already* projected and related to every thinkable referent, at every scale and temporality. This is the new metaphysic or rationality of 'subjectivist relationality' that shapes our everyday and present thought. The remaining chapters of this thesis will explore this subjectivist relationality, through the topics of temporality (chapter 7), and the connection of security to concepts of entanglement (chapter 8).

Welcome Home, Anthropos?

Declared from the echelons of the natural sciences, recent human interference with the Earth's systems has interrupted the operation of geophysical processes and cycles. This has created an unprecedented uncertainty concerning the capacity of the Earth to sustain humanity's encroachment (Biermann 2007). Hence, the Anthropocene, our new human-made epoch, ends the Holocene epoch of the preceding 10-12 millennia. It is a massive and complex concept aimed at highlighting humanity's deleterious impacts upon the Earth's natural systems. It is generally understood in three ways: First, as a new stratigraphic interval in Earth's geological history (i.e. geologists in the distant future will be able to discern planetary-wide changes captured in volumes of rock, ice, or sediment that are attributable to the human species alone); second, as a shift of the entire Earth system from its stable Holocene state of the past 11,700 years – within which humanity has flourished – into a new and unstable Anthropocene state of uncertainty; and third, as a "threshold marking a sharp change in the relationship of humans to the natural world" (C. Hamilton et al. 2015, 3).

The concept of the Anthropocene thus upsets the classical (meta)theoretical assumptions of IR and its billiard-ball models of states and international systems. No longer assuming a stable environment as its background context, it encourages IR scholars to question how statist ontologies and their concomitant Western and Enlightenment epistemological binaries of human/nature, inside/outside, and subject/object, operate within a transforming Earth system (see Fagan 2016; Harrington 2016). IR, therefore, must either reorient its focus on national and international institutions towards a form of planetary stewardship and Earth system governance (Biermann 2012), or it must aim at a radical new form of planet politics. "Geopolitics can now no longer take the context of the human drama for granted; transformations are afoot that are of humanity's own making" (Burke et al. 2016, 510).

Despite being silent in the 2000s, IR is now taking the Anthropocene's transnational scope and dire warnings of global catastrophic transformations in Earth systems, very

seriously. “Given the recent and uneven intellectual history of environmental IR,” notes Harrington (2016, 486), “the emergence of the Anthropocene concept is a watershed moment for IR scholars”. Why? Its emergence is assumed to end the old, traditional ‘world’ of international relations in which Nature was the stable, everyday background context for state-centric international and security problematiques of Cold War power politics (see Deudney 1990). In the Anthropocene, the logics and ontologies of states are transcended by a planetary-wide crisis operating at unprecedented spatial, temporal and even existential scales. In response, novel patchworks of global (environmental) governance are already altering the ‘structural geography’ of international relations (Pattberg and Widenberg 2015).

Through the Anthropocene’s (supposed) disruption of the “ontological dualism between human and nature that drags with it so much environmental damage” (Harrington 2016, 488), scholars generally agree that IR must evolve, although they differ on how and in what direction. On the one hand, some advocate managing or governing the planet as a whole through an interdisciplinary or holistic type of collaboration and change research, with “engaged analysts” working and flowing between the natural and social sciences (Castree 2014; Pattberg and Widenberg 2015; Biermann 2012, 2014). These perspectives embrace computerized models and metrics of the natural sciences to converse with, combine, or reform governance institutions in ways suited to the Anthropocene’s globalised topology.

On the other hand, many IR scholars suspect that these planetary governance institutions act as Trojan Horses for the same statist/dualist binaries that corrupted the environment in the old-fashioned *realpolitik* style of IR. They retain and exacerbate the same human/Nature and ontological and epistemological divides that IR must now transcend (Lövbrand et al. 2016). For this group, “International Relations, as both a system of knowledge and institutional practice, is undone by the reality of the planet”, because the Anthropocene “forces an ontological shift: human activity and nature are so bound together that they are existentially indistinguishable,” making a singular “social nature” (Burke et al. 2016, 501, 510). To put it bluntly, “IR is a malevolent ghost of the

planetary real" (2016, 512). A third group of scholars remains hesitant to take sides. Although acknowledging its dangers, Fagan notes that the Anthropocene promotes understandings of security and the environment that are always already co-constitutive and entangled. This causes human/culture binaries to be present and enacted through any discussion of the environment and/or security, thereby removing the critical potential of analyses invoking environmental security to think differently (Fagan 2016).

Yet, all of this IR scholarship shares the same basic assumption that the concept of 'the Anthropocene' is, in some form or another, an impending reality; a scientific fact, and an inevitable future for IR and the planet. It is thus assumed as the new and self-evident background condition that humanity and international politics will soon, and must, engage. Literature either focuses on the potential effects or transformations engendered by the Anthropocene upon politics and subjectivity in the present, or it theorizes new forms of international, global, or planetary politics demanded by the Anthropocene in the future. Quite uniformly, however, concepts borrowed from the theoretical physics and modelling simulations comprising the Anthropocene – such as GCMs, and the 'planetary boundaries' model (Rockström et al. 2009. See below) – are used and celebrated without questioning *how* these concepts and their implicit boundaries emerge in the Earth system sciences (ESS), and thus how they may subsequently orient the thought and conduct of IR theorists when they are imported and invoked without question.

For instance, Biermann (2014, 34) notes how "The core idea of the concept of earth system boundaries is quantification and (increasing) precision". He asserts, therefore, that "While the concept of earth system boundaries is normatively neutral, its implementation is not" (2014, 34). Likewise, even the self-proclaimed "manifesto" of Planet Politics dedicates a large section towards praising the advantages of using ESS over IR. Through ESS, "We have moved past debating the truth of global climate change and its prevention to having to think about how we are going to live in the world we have created" (Burke et al. 2016, 505). However, as this chapter argues, embracing quantified scientific boundaries as the basis for concepts that are rendered thinkable only

through GCMs and ESS models, is not a neutral practice. Rather, quantification allows us to think and imagine some things, but it brackets the possibility of thinking others. When IR scholars unquestioningly adopt and incorporate these ESS concepts into their work and thought, what is not amenable to its style of mathematical projection and calculation is subtly concealed or bracketed (also, see chapters four and five).

Without being able to sense and construct a political and public world, and instead being entirely reliant upon ESS concepts rendered thinkable only through supercomputers, a mathematised and calculatory rendering of objective reality results. With only theoretical physics delimiting this new 'world' for IR, there is no option but for the Cartesian self – i.e. the 'I' as the locus of self-certainty – to assume centrality. It "puts man back once more—and now even more forcefully—into the prison of his own mind, into the limitations of the patterns he himself created" (Arendt 1998, 288). How does this process of subjectification occur? It is now to what underpins both ESS and planetary boundaries in the Anthropocene – *carbon and climate change* – that this chapter turns.

From Climate Change to the 'Making' of Nature

Whether it is the planetary boundaries model, the natural or social sciences, studies of global change, or IR, "Climate change gets prominent mention in the literature of the Anthropocene" (Burke et al. 2016, 511). In common parlance, it is the leading representative, the driving force, the "most comprehensive token of this entanglement" of natural and social processes visible today (Hastrup 2013, 1). In other words, it is rare to read about the Anthropocene without it being situated in discourses of global climatic change. As noted in chapter 5, it was this notion of a failing or broken climate that prepared the conceptual grounds for the Anthropocene we know today. "The idea of global climate being nudged into an alternative state by human impacts [were] extended beyond climate to encompass the Earth system in its entirety" (Clark 2016, 132).

As noted in chapter 3, prior to inventing the Anthropocene in 2000, Paul J. Crutzen was an atmospheric scientist that pioneered the popular concept of global climatic nuclear winter (Crutzen and Birks 1982). Indeed, he later defined the Anthropocene from its outset as emerging on similar climatic terms, through a globality of catastrophe made traceable through GCMs and carbon: "Because of these anthropogenic emissions of carbon dioxide" starting from the industrial revolution, he wrote, the "global climate may depart significantly from natural behavior" (2002, 23).

Likewise, another pioneer in Anthropocene studies, Will Steffen, celebrated that the Anthropocene emerged from decades of research in the International Geosphere-Biosphere Programme (IGBP) and partner programmes of the World Climate Research Programme (WCRP), the International Human Dimensions Programme on Global Environmental Change (IHDP), and an international programme engaging biodiversity science called DIVERSITAS, by asserting its climatic roots: "The origins of the concept [global change] are largely derived from the careful and consistent measurement of atmospheric CO_2 concentration at the Mauna Loa Observatory in Hawaii", because these observations "first demonstrated beyond a doubt that human activities can have direct global-scale consequences for the environment" (Steffen et al. 2004, 4). Here, the rationalities and technologies that brought global climate change into being – subjectively, socially, scientifically, and politically – formed the basis for studies of Earth systems, global change, and the Anthropocene, that IR embraces today. After the year 2000, it became commonsensical that disturbing the climate meant disturbing the Earth system. "By the same logic, awareness of the need to prevent anthropogenic activity from pushing climate into a danger zone of potentially abrupt climate change was shortly extrapolated to the other major components of the Earth system" (Clark 2016, 132).

Importantly, it should be noted that the Anthropocene is not solely climatic nor limited to carbon dioxide (Steffen et al. 2004, 7). It now encompasses ecological and biogeophysical cycles of nitrogen, phosphorus, water, agriculture, urbanization, and so on. The point, however, is that even seventeen years after the invention of the

Anthropocene by Crutzen, it remains fixated to, and grounded upon, *global climatic change*. We know of the Anthropocene primarily "from scientific labours in fields such as climate science" (Wark 2015, 120; Clark 2016). Yet, the concept's multidisciplinary appeal now stems from a broad and inclusive scope that has assimilated climatic globality, and moved beyond it into a broader Earth science and Global Change studies (Steffen et al. 2004). To think about the Anthropocene, therefore, is now "to think together Earth processes, life, human enterprise and time into a totalizing framework" (Hamilton et al. 2015, 2). If this is the case, then what is the best way to problematise and analyse the concept of the Anthropocene?

With *anthropogenic* global climate change forming its discursive background, it remains commonplace to hear that the Anthropocene is now 'made' by humans as well. For instance, Wark notes how this human-made epoch results from selfish, neoliberal material consumption: "The Anthropocene is a series of metabolic rifts, where one molecule after another is extracted by labour and technique to make things for humans" (2015, xiv). However, there is another more common framing of human 'making' in the Anthropocene that is (philosophically) much more problematic, and is the focus of this chapter.

As noted above, today the Anthropocene is framed in terms of normative responsibility and political and geophysical destiny. It is an epoch made by, and thus chosen or *decided by,* humanity. Acknowledging the Anthropocene as the new age of humanity is "precisely to make it clear that the planet's ecosystems, and possibly its global climate too, have been in part a human artifact" (Dalby 2014, 5). Indeed, to take a recent and notable example from IR:

> …to call present circumstances the Anthropocene means to 'ontologically foreground' the geophysical scale of human agency in the biosphere; . . . Nature is being dramatically reshaped by social actions so problems of democratic representation now take on even deeper importance: who decides how nature is to be remade, what the future human condition is to be?

(Burke et al. 2016, 512)

Claims and comments like these are now common in literature across IR and the social and natural sciences. It has become normal to read that the Anthropocene designates humanity as makers and masters of Nature, and thus reconstitutes or recalibrates our very 'human condition' (Hamilton et al. 2015; Grove 2015). This begs important questions, however, that scholars embracing 'the Anthropocene' do not ask. What is it to 'make' something? What does it mean to 'make' Nature, the climate, and/or the human condition, in the Anthropocene?

Upon examination, the ease and frequency with which these claims are made perhaps reveals more about how the Anthropocene orients our own political subjectivity and rationality, than it does about Nature, the planet, or our modern geological epoch. Indeed, Clark has recently and astutely noted that "progressive thinking" around the Anthropocene and its supposed rupturing of subject/object and culture/Nature binaries makes "co-enactment or mutual entanglement the order of the day (Clark 2016, 134. See chapter 8). So, rather than take the normative implications of 'making Nature' at face value and proceed to examine the future ethical conundrums raised by the Anthropocene (see Zylinska 2014), the key becomes asking *how* these assumptions and claims are even possible.

As Foucault phased it, this is to analyse how one governs themselves and others through the truths produced and concretised in particular problems, and made intelligible through practices such as the ESS (2002d, 230). In the case of the problem of the Anthropocene, therefore, this is accomplished not by debating the accuracy of the sciences behind it, nor by calling for a more noble form of politics. It is by examining the conceptual and philosophical foundations that make claims to 'make Nature' commonsensical and *thinkable* today.

Philosophical foundations are important. They ground our thinking and Being in the world. Reflecting upon Nature and the human condition, Arendt established 'making' as

an integral component of human life, world, and Earth (1998). As discussed in chapter 2, the human condition refers not to any universal or immutable human nature. "Men are conditioned beings because everything they come in contact with turns immediately into a condition of their existence" (Arendt 1998, 9). In this sense, at first, the world appears to be whatever humans 'make' of it. Yet, this worldly conditioning can never become, replace or determine Nature itself. The capability to condition or understand the totality of Nature lies always *outside* of human comprehension, because whatever 'Nature' is, it is always preceded by a pre-reflective and social worldly reality that conditions and gives formative rise and boundaries to every thought. Even with advancements in natural science, therefore, it is unlikely that "we, who can know, determine, and define the natural essences of all things surrounding us, which we are not, should ever be able to do the same for ourselves—this would be like jumping over our own shadows" (1998, 10, 298).

Interestingly in the case of the Anthropocene, this means that our human world can never 'condition' us so absolutely that it becomes symbiotic with, makes, or overpowers, Nature. The human can make things *from* Nature, but cannot make Nature itself; humanity stands always apart. Why?

As discussed in chapter 4, the *vita activa* is what orients the elemental capacity of all humans to engage in *labour*, *work*, and *action*. It frames the innumerable patterns and combinations of human subjectivity and political possibility across human history. By tracing Western political thought from the ancient Greeks to modernity, Arendt stresses that *homo faber* (i.e. the human maker) is antithetical to the biological cycles and processes of Nature. 'Making' involves the construction of artifices from the materials of nature, so as to build a shared human world of artifacts where politics, culture, and action, may then occur. Thus, making always does 'violence' to Nature by removing its materials from the timeless and cyclical biological and geological processes of the Earth. This makes a world of finite things and artifacts that gives brief respite to mortal human lives amidst an otherwise infinite and immortal Nature. Imbedded "in a cosmos where everything is immortal except themselves", it is only *homo faber's* making of

artifacts that can "guarantee the permanence and durability without which a world would not be possible at all" (1998, 94). When compared to the circular and eternal recurrence of Nature, therefore, a world human-made is finite, and like human life, *rectilinear*. Humanity, and its artifacts, thus cannot be combined nor conflated with Nature. Ironically, the 1987 Brundtland Report, 'Our Common Future' – a precursor for the IPCC, UNFCCC, and global environmental politics writ large – was incidentally correct regarding this matter: "The Earth is one but the world is not", it wrote (WCED 1987, 27). The world is one of finitude and particularity, or, what humans can make *from* the Earth.

When considering the Anthropocene, however, instead of *homo faber* using Nature to make a world, Nature itself becomes human-made. Again, citing Wark (2015, 169): "collective human labour is causing climate change . . . [and] In the Anthropocene, some neutral, pre-given planetary nature is no longer available as a fiction of the real. We fucked it up". Or, as Dalby (2013a, 185) phrases it for IR (in a less incendiary tone): 'the Anthropocene suggests very clearly that the future of the biosphere is an open question: what kind of nature gets produced is now the political question of our times' (2013, 185). Here, it appears at first that the Anthropocene fosters humility by asking what type of a planet, biosphere, Nature, or epoch, humanity is now 'making'. However, the relationship between biological and natural cycles, and the constitution of human subjectivity through the *vita activa*, is here ignored or simply forgotten. Nature is no longer out of bounds for the human world, and this has important effects upon how we think of Nature – subjectively and objectively – in the Anthropocene today.

As will be explored below, asserting that we as humans now make Nature, does not foster self-reflection, nor reconcile humanity with an Anthropocene ethics of entanglement. Instead, it belies and exemplifies an implicit celebration of the human subject as lord and master of Nature and the Earth.

Science, Rationality, and Biopower: A Biopolitics of Carbon

Foucault's concept of governmentality was outlined in chapter 2 as the ability to shape and delimit the forms of truth and knowledge constituting subjectivity. By orienting how the "conduct of conduct" is thought, the possibilities for action(s), are likewise determined.

Whilst theorizing global (environmental) politics in IR, many scholars have also recently turned from governmentality to the analytics of biopolitics (Foucault 1990; 2003; 2007; 2008). Taken literally, the Greek prefix *bios* implies that bio-politics is a politics of life. Since the late 1970's, the use of Foucault's concept of "a biopolitics of the human race" (2003, 243) has been used in a wide variety of disciplines and contexts, and is increasingly theorized in conflicting or even contradictory ways (Lemke 2011, xi). Rather than explore differing accounts of biopolitics made by theorists such as Agamben on thanatopolitics, or Hardt and Negri on biopotenza (for an overview, see Coleman and Grove 2009; Esposito 2008), this chapter elaborates and extends the globality of biopolitics as framed by Foucault, Arendt, and Heidegger.

It is worth reviewing here that for Foucault, biopolitics emerged in the 15th and 16th centuries during the transformation of Western political reason identified in this thesis as the Cartesian Moment. It was a technology of power that redefined how humans lived in a polity. To instill order within a territory, human bodies were no longer placed under the sovereign power of a King as subjects, or under the legal and juridical power of canonical law. With the emergence of biopower, social order could be instilled through a "power that take[s] control of both the body and life or that has, if you like, taken control of life in general—with the body as one pole and the population as the other" (Foucault 2003, 253). Applying strategies of calculation – derived from the natural sciences and physics of the time – to a seemingly chaotic flux of human bodies, this population arithmetic or 'statistics' was found capable of measuring and describing patterns of life operating within the polity: birth and death rates, health and illness, and so on. This biopower disclosed norms and standards through which authorities and

individual subjects could then govern themselves and others without applying violence or direct force (Foucault 2003: 253, 243; 2002d).

As noted in chapter 2, this practice of rendering biopower thinkable through statistical calculations became essential for biopolitics and governmentality analytics in IR today (Busse 2015). It is thus typical to read that biopolitics is "a form of politics entailing the administration of the processes of life of populations" (Dean 2010, 117), or that it "refers to the emergence of a specific political knowledge and new disciplines, such as statistics, demography, epidemiology, and biology" (Lemke 2011, 5). In sum, it is assumed in IR that the statistical and biopolitical discovery of the population allowed the concept of 'society' to emerge (Neumann and Sending 2010, 41, 12; see also Dalby 2013a, 186).

Chapter 2 also argued that biopolitics and governmentality remain framed through the same basic rationalities and concepts originally used by Foucault in his analysis of early-modern natural sciences. Although the theoretical physics and scientific processes undergirding global climate change and the Anthropocene have long since changed from Foucault's analysis of the population arithmetic of the physiocrats, the correlation of these new ESS physics with conduct and rationality today, remains unexamined. If indeed physics is the permanent correlative of politics (Foucault 2008), then we must now inquire into how the Anthropocene is made thinkable through these sciences and the physics of ESS. It is in this bottom-up approach that new forms of governmentality or biopolitics may emerge from Anthropocene discourses.

With this goal in mind, this chapter turns now to how the technological rationality underlying GCMs, ESS, and computer simulation models – the concepts and sciences which IR scholars have now taken for granted in 'the Anthropocene' – are assumed to 'make Nature' and its new human world.

The Carbon Atom in IR: 'Making' the Golden Spike

Carbon is the building block of every single organic molecule on earth. It is the atomic and biochemical foundation of all life (Lövbrand and Stripple 2006). "Its atom acts like a neatly symmetrical tetrahedron that can link up with other atoms in an almost infinite variety of forms", releasing energy stored within carbon molecules through processes such as burning and metabolism (Young 1977, 65). With every breath that humans and animals exhale, we emit carbon dioxide from the molecular metabolism of our food. "Even the earth itself breathes out carbon dioxide; large amounts are emitted in every volcanic eruption" (Young 1977, 65). As carbon dioxide is returned to the atmosphere, and carbon is distributed and absorbed by the Earth's oceans, biosphere, and geosphere in a global cycle, carbon atoms will "flit back and forth between plants, soil, air and water for approximately 100,000 years" before returning to rock or sediment (Boyle and Ardill 1989, 22).

Like Nature and the human body, discourses of global climate change and the Anthropocene are also driven by carbon. When discussing the Anthropocene, "the CO_2-climate connection is now so well entrenched in public consciousness that it is often regarded as the single greatest environmental threat to the future well-being of humankind" (Raupach and Canadell 2010, 210). Carbon has become the representative, or "shortchange", for all greenhouse gases (GHGs) now causing global climate change (Methmann and Stephann 2015). The point here is that carbon – the atom of all life – is absolutely central to humanity, climate change, and the Anthropocene's recent emergence as a planetary phenomenon. In IR, "Climate politics is obsessed with carbon. . . . Climate politics is essentially carbon politics" (Methmann and Stephann 2015, 282). Likewise, climate science is essentially carbon science.

There exists a growing literature on ways that carbon is brought into being today through climate governmentalities (Lövbrand and Stripple 2011; Stripple and Bulkeley 2014), practices of calculation, ordering, and accounting (Lövbrand and Stripple 2006; Gupta et al. 2012; Dahan 2010), the shaping and conducting individual and collective

carbon subjectivities (Paterson and Stripple 2010; 2012; Rutland and Aylett 2008), territorialisation and governance through local, national, and trans-national mechanisms (Boyd 2010; Rice 2010; Methmann 2012), and even through imaginaries of planetary catastrophe (De Goede and Randalls 2009). Yet this chapter differs from these accounts by seeking the scientific and technological rationality underpinning them. In doing so, it avoids the applicationist tendencies of governmentality in IR to reduce every 'thing' to an outward manifestation of neoliberal conduct.

For instance, although Methmann and Stephann (2016) highlight the importance of the carbon atom to whilst discussing a "carbon governmentality", they do not question any of the ESS and GCM frameworks underpinning their use and engagement of carbon. Its incorporation into climate and Anthropocene discourses is once again treated as a self-evident scientific fact.

In brief, these authors assert that carbon is: first, a global phenomenon that is managed through the UNFCCC or IPCC through a "God's eye perspective" akin to biopolitical management (2016, 286); second, that carbon's "atomization" is clearly indicative of neoliberal governmentalities introducing market mechanisms to govern its global reach, through protocols such as the 1997 Kyoto Protocol or carbon trading schemes (2016, 287). In a similar vein, the recent Planet Politics manifesto also reifies the science of the ESS in order to critique IR: "Its analytical breadth and methodologies underpins much of climate science, and now issues a profound warning to global institutions – if they are in any mind to hear" (2016 Burke et al., 505). In short, according to these authors, without ESS the discipline of IR can no longer analyse nor respond to "the evolving planetary real" (2016, 505). Yet, what the ESS is, and *how* it brings carbon into being, is unexamined and assumed to be self-evident.

Although the Anthropocene is comprised of much else besides carbon (Steffen et al. 2004; also, see above), an entry point into the rationality underpinning carbon and ESS is visible in the recent debate over its formal stratigraphic boundary. This boundary marks the first noticeable changes recorded in the planet's stratographic sections of rock

and ice, and it is commonly known as a "golden spike" or GSSP (Global Boundary Stratotype Section and Point).[1] In short, the Golden Spike Debate revolves around two camps: on the one hand, scientists that believe the Golden Spike must represent a transformation in the overall operation of global and planetary systems (C. Hamilton 2016). On the other hand, are scientists that believe the Golden Spike must represent a uniform and global GSSP signal that covers the entire Earth uniformly, like a thin layer or blanket (Lewis and Maslin 2015). However, both sides of this debate highlight the centrality of the carbon atom and nuclear discourses in the scientific and political imaginaries of the Anthropocene, and each potential GSSP marker.

For instance, when Crutzen first set-forth the concept (Crutzen and Stoermer 2000) he labeled the combustion of fossil fuel CO_2 emissions at the beginning of the Industrial revolution, and the global fallout of radioactive nuclides of carbon-14 from atomic bomb tests in New Mexico in 1945, as the leading contenders for the GSSP spike of the Anthropocene. He later added the 'Great Acceleration' of industry and population booms after the Second World War (Crutzen 2002). In an article bridging both sides of the debate, Zalasiewicz et al. (2011) also asserts that "The chemical perturbation of carbon is probably the most important [chemostratigraphic marker], because of its potentially far-reaching, long term, and cascading consequences for the whole Earth system" (2011, 1041). Even more recently, Lewis and Maslin (2015) have identified 1610 and 1964 as two globally synchronous markers for the golden spike. The former, 1610, represents "the collision of the Old and New World" which resulted in the death of over 61 million people and a global decline in atmospheric CO_2 of 7-10 ppm (parts per million) through the homogenisation of Earth's biota; the latter date, 1964, represents atmospheric radionuclide carbon-14 fallout from the global peak of nuclear weapons testing. Tellingly, both of these proposed spikes are highly (bio)political in nature, ranging from imperial conquests, colonialism and genocide, to nuclear war and planetary extinction. Yet, both are always understood through carbon as the primary medium and measure.

[1] The recent 'golden spike' debate and its relation to political temporality and eschatology is covered in greater detail in chapter 7.

From atmospheric CO_2 levels to the nuclear fallout of carbon-14, therefore, the Anthropocene depends upon how the carbon atom is appropriated into local and global cycles. "From a practical viewpoint, a globally identifiable level is provided by the global spread of radioactive isotopes from the atomic bomb tests of the 1950s, but this event is considerably later than the onset of increased levels of anthropogenic gases resulting from industrial processes [i.e.CO_2]" (Zalasiewicz et al. 2011, 1050). If carbon is the atom of life, and biopolitics explores how life is harnessed by political rationalities, then there exists a link here between scientific representations of Nature, carbon, and a new form of global (bio)politics that should be explored by disciplines such as IR.

How does IR engage this debate? It channels and embraces the Anthropocene through the new and growing discipline of ESS (see Biermann 2014, 2007, 2012; Galaz 2015; Lövbrand et al. 2009). ESS aims to capture "the past and the future evolution of our planet" by coupling highly technical mathematical models of the Earth's various systems together into integrated assessment models (IAMs), in a multidisciplinary type of "socioeconomic/climate integration" (Dahan 2010, 283). The aim of ESS is to combine the agency and worldliness of humanity, with the biogeochemical processes of the Earth. Its goal is to form "a holistic super-discipline that tries to embrace all processes in nature and society as one interlinked system" (Lövbrand et al. 2009, 8). Basically, it does so by integrating all of the Earth's 'spheres' – from the biosphere and the atmosphere, to the magnetosphere and the cryosphere – and then computes how they interact with human society. This integration is calculated by parameterizing the Earth's planetary *and* socio-economic processes, translating them into bounded and measurable variables to be modelled and combined. This computerized data, acquired through atmospheric, oceanic, and land models, is coupled together to shed light on the integrated functioning of the Earth's systems. Through it, the "potential synergies between bio-physical and socio-economic trends becomes startlingly apparent" (Steffen et al. 2004, 6). At the shared conceptual root of climatic and Anthropocene globalities, therefore, are computerised simulations of Nature.

Recently, scholars of all theoretical dispositions commonly incorporate the Anthropocene and ESS into their literature through the popular 'planetary boundaries' model set forth by Johann Rockström (2009). The goal of the planetary boundaries model is to reveal "a safe operating space for humanity with respect to the functioning of the Earth System", and it is rare to see a publication mentioning the Anthropocene that lacks mention of it (Rockström et al. 2009, 31. In IR, see Dalby 2014; Harrington 2016; Burke et al. 2016; Biermann 2014). This framework 'dovetails' with both the Anthropocene's and IR's recent concerns of a total human-induced shift in the Earth system by stressing "the same basic idea: . . . the boundaries of the earth system that need to be observed in order to maintain the potential for human development and well-being" (Biermann 2014, 33). In general, the planetary boundaries model integrates human society into the operation and stewardship of nine critical Earth ecosystem cycles, systems, processes, and thresholds. They are parameterized into control variables, which are then measured as nine boundaries (i.e. climate change, ocean acidification, stratospheric ozone, phosphorus and nitrogen cycles, atmospheric aerosols, freshwater use, land use change, biodiversity loss, and chemical pollution). Approaching boundary thresholds thereby foments catastrophe, and a "move into an undesired state for humanity on planet Earth" (Rockström 2010, 72).

The planetary boundaries model has been critiqued for failing to succeed in its attempts to be explicitly incorporated into state policy and 'summaries' for policymakers in venues such as the IPCC (Dryzek et al. 2013, 115-116); amongst scientists for its questionable use of data and selection of boundaries (see Galaz, 2015); and for its anthropocentric celebration of "the human enterprise" as a Euro- and Western-centric imperial type of civilisation (Crist 2013). Yet, despite these critiques, the model has made a tremendous impact upon scholarly and public consciousness. It has become integral to political applications of the concept of the Anthropocene. Indeed, "While scientific interventions rarely are directly translated into policy interventions they do, however, produce ideas, concepts and tools that may affect how political life is understood and enacted" (Lövbrand and Linnér 2015, 45). Whether it is a reformed

Earth system governance or a paradigm-shifting type of planet politics, therefore, the idea and concept of the Anthropocene is now understood in IR through these quantified planetary boundaries of ESS. It is "rightly advanced as 'a new paradigm that integrates . . . human societies and the maintenance of the Earth system", that IR needs to adopt (Burke et al. 2015, 506). If, following Foucault, this type of Earth science is correlated with dominant political rationalities emerging from them – i.e. if its physics *remains correlated* with political rationality – then we must ask *how* the ESS shapes thinking concerning life and Nature in implicit ways perhaps taken-for-granted today.

If humanity chooses to remain within its planetary boundaries, it safeguards life: "we give ourselves a long-term safe operating space for human development on Earth . . . providing ample opportunities to support long-term social and economic development in the world" (Rockström 2010, 73). Scholars have long argued that any such global limits, boundaries, or norms automatically elicit Foucauldian notions of disciplinary power and normalization (see Foucault 1979). For instance, Lövbrand et al. (2009, 10) argue that ESS reflects an "Earth System governmentality" that projects a new "world picture" to govern humanity in the Anthropocene. Planetary boundaries are here conceived as "efforts to monitor and manage the Earth System . . . shar[ing] characteristics with Jeremy Bentham's design in the 1780s of a prison (the Panopticon) that enforces the expectation of a singular 'eye of power'" through a totalizing global gaze (Lövbrand et al. 2009, 11). As Rockström et al. state, these boundaries do indeed determine the Earth's "rules of the game" and "as it were, define the 'planetary playing field' for the human enterprise" (2009, online). Applying panoptic disciplinary power and norms here to ESS boundaries is indeed tempting, as chapter 4's discussion of GCMs in the IPCC argued. Again, bordering on a top-down form of anti-universalism, "Rather than the view from nowhere", notes Hulme, these "global kinds of knowledge claim to offer the view from everywhere", thereby fostering "managerialism on a planetary scale" (2010, 559, 561).

Yet, to glimpse at ESS and its projection of planetary boundaries 'safeguarding' humanity, this attribution of panoptic or disciplinary rationalities once again runs the

risk of a top-down *applicationism*. With declarations from ESS that the goal is planetary stewardship, management, and to conceive of all life as one integrated system delineated within carefully monitored 'safe operating spaces', it no wonder that IR scholars translate these planetary boundaries into extensions of human agency at the global scale: "to make it clear that the planet's ecosystems, and possibly its global climate too, have been in fact a human artifact" (Dalby 2014, 5). Instead, understanding how ESS 'makes' Nature thinkable for us, as quantified artifacts and rigid planetary boundaries, becomes crucial: through mathematical and computerized simulation models.

Like the scientific processes operating in the Natural Law in the 16th and 17th centuries, today, these simulation models are "a manifestation of our scientific knowledge (or lack thereof) and our technical capacity in terms of modern computational science" (Verburg et al. 2016, 311). Everything we know about the climate, global cycles, Earth systems, and hence the Anthropocene, we know only through these simulations computing unprecedented global scales and complexities.

Further to this, the ESS and its planetary boundaries not only incorporate GCMs today, but developed directly from them as well. Not coincidentally, it was only beginning around 2000 that "the carbon cycle and its feedback on various environments, from the atmosphere to the ocean and to vegetation cover," became a prominent component of coupled climate and biogeochemical models (Dahan 2010, 286). Here, Dahan (2010) has detailed how the international recognition of climate change in the 1990s fostered a "hybridization" of science and politics, leading to greater international pressures to both research, and to know, life at a global (climatic) levels. "In the 1990s, climate modeling underwent major transformations, increasingly linked to the emergence of the issue of climate change", with the most prominent being "the acceleration of the so-called coupling activity and the integration within models of a growing number of environments" (2010, 283). From this, the climate system assimilated socio-economic spheres, along with the other 'spheres' of the Earth, into the *Earth System*. Hence, the simultaneous rise of discourses of the Anthropocene in 2000, and the incorporation of global carbon cycles into climate politics and regimes such as the Intergovernmental

Panel on Climate Change (IPCC) after 2000. Globalisation is here associated not simply with capital flows or neoliberalism, but with climate technologies and models combining so as to integrate society into the Earth system itself (Heymann 2010b, 593). Carbon is once again the medium here for life and politics.

Indeed, prior to 2000, global carbon cycles were not a focus of the IPCC, nor climate change research. Yet after 2000, just as the Anthropocene was brought into being as a new human epoch, atoms of carbon were then able to be applied to these complex new couplings of global circulation models, which now had enough computational power to accurately link the Earth's 'spheres' together. When these quantified projections of *global* carbon flows were then applied "to the living man, to man-as-living-being; ultimately, if you like, to man-as-species" (Foucault 2003, 242), then a new way of thinking and computing the physics of atmospheric fluid dynamics appears through Anthropocene discourses. What appears at first glance to be disciplinary power or a managerial panoptic gaze (see above), is actually buttressed and transcended by this coupling of global spheres and humanity together through, the tracing of atmospheric carbon. Not top-down, but also bottom-up, from the atomic scale.

Contrary to Biermann's claim that ESS and planetary boundaries are normatively neutral, therefore, here they bring Nature and life into thinkable being in very specific ways: as simultaneously atomic and global, through Earth System models, and through a coupling and fusion of socio-economic and climatic integration. This was the biological and organic version of carbon, as life, moving over the globe; equal in power to what had previously been considered as CO_2 that was affecting the radiative forcing of the atmosphere. This new biological understanding of global carbon cycles has since caused "the processes of living matter and the question of carbon [to] have moved the goalposts and transformed the various debates" (Dahan 2010, 288). From the smallest of atomic scales to the most gigantic and complex of planetary processes, after 2000, humanity in the Anthropocene is homogenized and reconstituted as carbonic life – and with it, the entire Earth System is thus able to be placed in "a numerical box" (Dahan 2010, 291).

Through ESS and coupled GCMs, this is all blended together in a computerised form, calculating and quantifying itself alongside Earth and Nature "to the extent that they [humanity] form, on the contrary, a global mass that is affected by overall processes" (Foucault 2003, 242-3). This is a not a simple case of disciplinary or panoptic power, therefore. It is a new form of biopolitics, grounded not upon population or society, but upon the physics of calculating new thermodynamical and physical processes that capture life as mathematized, atomic, and global flows of carbon.

Making Atoms: An Excess of Carbon and an Excess of Biopower

As noted in chapter 3, the GCM models of today's climate science were not originally developed to trace the carbon atom we are familiar with in climate or Anthropocene discourses. They were first developed after World War II to detect a special form of carbon that even Arendt declared *was* 'made' by humanity: radioactive isotopes of carbon, or the carbon-14 created in the fission process of atomic and nuclear bombs (Edwards 2010; 2012). This is an inorganic carbon of death. And yet, as Masco has illustrated (2010; 2016), tracking atomic fallout is what allowed the atmosphere and biosphere to emerge as a new type of global and ecological territory.

As the so-called 'Father' of the atomic bomb, Robert Oppenheimer (1947, 55) wrote, "The interior of an exploding fission bomb is, so far as we know, a place without parallel elsewhere. . . In the crudest, simplest sense, it is quite true that in atomic weapons man has created novelty." When it comes to carbon, the Anthropocene's roots do not reside in its current assertions of making and mastering Nature so as to steward life. Rather, humanity's real 'making' of Nature is on this atomic level, associated with the extinction of Earthly life from the most genocidal weaponry ever devised by humanity. "To our knowledge such things [the making of Nature] do not happen except in the atomic weapons we have made and used" (Oppenheimer 1946, 55). Tracing Earth systems to govern the Anthropocene, therefore, is an echo of tracing mushroom clouds.

According to a recent article in *Science*, the planetary and global spread of nuclear fallout from World War II and the nuclear bomb tests following it, are indeed "the most widespread and globally synchronous anthropogenic signal . . . [which] left a clear and global signature" upon the Earth. It disseminated radiocarbons identifiable for the next 100,000 years across the sediment of the globe, marking the golden spike of the Anthropocene epoch (Waters et al., 2016: aad2622-5). Scientists now casually assert that "Like life, the Anthropocene is carbon-based", although this carbon is actually inorganic, human-made, nuclear, and planetary in its scope (Raupach and Canadell 2010, 211). Rather than a top-down or panoptic ESS, therefore, the rationality underpinning the science of the Anthropocene and planetary boundaries must include this "Bomb or 'excess' radiocarbon [which] provided the first highly effective way to trace the path of individual parcels of air at high altitudes" (Edwards 2010, 30). As ESS traces and integrates global cycles of organic, inorganic, and radionuclide carbon, it congeals into the integrated Earth systems of the Anthropocene as this 'excess of carbon'. Carbon, quantified, as both life *and* death.

With this thesis having traced the globality of climate change and the Anthropocene to nuclear discourses, GCMs, and the paradox of climatic knowledge as increasing inaction, then it should strike IR scholars that Foucault himself reflected on nuclear catastrophe, the atomic bomb, and radiocarbon fallout, as "a paradox" (2003, 253). Foucault's paradox lies not in the fact that the atomic bomb can kill hundreds of millions of people, since "after all, that is traditional" or within the decision-making power of the sovereign. Instead, the biopolitical paradox of nuclear radiocarbon lies in the fact that "The power to manufacture and use the atom bomb represents the deployment of a sovereign power that kills, but it is also the power to kill life itself" (Foucault 2003, 253). Biopower is a power to utilize, steer, conduct, or safeguard life, but it is also the sovereign's biopolitical right to kill at their own discretion. This new atomic power is thus an "extreme power" that suppresses, is antithetical to or "is in excess of biopower". Atomic carbon is a re-making of life that, if let loose, eviscerates itself. It is an 'entanglement' of life and death. This paradox spurred Foucault to posit an "opposite extreme" comprised by excess carbon and atomic power, which presciently

reflects what we see before us in discourses of global climate change, the Anthropocene, and the planetary boundaries model of ESS:

> [It is] a biopower that is in excess of sovereign right. This excess of biopower appears when it becomes technologically and politically possible for man not only to manage life but to make it proliferate, to create living matter, to build the monster, and, ultimately, to build viruses that cannot be controlled and that are universally destructive. This formidable extension of biopower, unlike what I was just saying about atomic power, will put it beyond all human sovereignty.
>
> (Foucault 2003, 254)

Foucault is not claiming that this 'excess of biopower' must be a virus on par with the mass death wrought by the atom bomb. Nor is he claiming that the state or its sovereign power will itself disappear, since "The state is nothing else but the effect, the profile, the mobile shape . . . [and] the mobile effect of a regime of multiple governmentalities" (2008, 77). Instead, what this strange notion of an excess of biopower implies, is a power or form of life that overflows the technological and sovereign power and authority of the state, and even of atomic and human power, without (necessarily) destroying them nor being controlled by them. Contrary to the scientific processes delimited by Natural Law which led to the discovery of a predictable and cyclical biopower, this "excess of biopower" is different. As discussed in chapters 2 and 3, nuclear physics (and the GCMs tracking the fallout of its bombs) could not be completed by hand, nor through numerical or statistical calculations. To be cognised and known, its processes required supercomputers to process and a rudimentary form of quantum science to theorize; *both* of which are far too complex and inconceivable to be grasped by the human mind and translated into speech, let alone be applied to politics. As a medium, they rely entirely on the application of physical and natural sciences such as ESS, and computerized simulations of Nature such as GCMs and IAMs, to enter thought as specific concepts. And so it is these concepts, as Foucault's "excess of biopower", or Edwards' "excess of carbon", that is now applied to international relations

today, as a carbon politics of the Anthropocene and its planetary boundaries (Dahan 2010; Methmann and Stephan 2016).

How can we grasp the physical processes that shape the boundaries of this new Anthropocene concept? Humanity claims to make Nature, and indeed, shares carbon as a substrate. This substrate is now rooted in the Anthropocene's emergence in nuclear carbon, and its materialisation today through GCM supercomputers. This carbonic biopower thus reconstitutes the boundaries of the social, the political, the governmental, and the human world, from unprecedented spatiotemporal scales ranging from the atomic to the global. "All this is held together, though the matter of carbon. Carbon is the linchpin between the global and the local, between public and private, and between hierarchical, science-based management and the flexibility of markets" (Methmann and Stephann 2015, 288). This is a carbon that is both subjectifying and objectifying: the human being and all life is carbonic, and yet integrated into an incalculable globality of carbon flows, markets, cycles, and Earth systems. If biopolitics grasps at life, then this is, in other words, a global biopolitics of carbon.

As Arendt predicted long ago when reflecting on nuclear weapons and atomic carbon, this technological rationality portrays a humanity and a biopower that will "no longer observe or take material from or imitate processes of nature but seem actually to act into it . . . to have carried irreversibility and human unpredictability into the natural realm" (1998, 235). Rather than protecting and repairing *homo faber's* fabricated, human-made, rectilinear world of artifacts against an endless erosion from the eternal tides and cycles of Nature, "keeping them as far as possible outside the man-made world, [modern humans] have channeled these forces, along with their elementary power, into the world itself" (1998, 148-149). This is the world of the Anthropocene, where the human self reacts to this excess of incalculable scales and temporalities of carbon, by reflecting and turning inwards to itself. The carbonic subject is the only place where self-certainty remains, and it asserts that it retains some influence and control over Nature, by – for example – deciding what kind of life and planet to make as its master, steward, and its destiny (Dalby 2013a; 2013b). Hence, the Anthropocene epoch, the human age.

This chapter now moves on to describe how, through technological calculation and representation, this global biopolitics of carbon operates. Through the philosophy of Heidegger, it explores how carbonic biopolitical boundaries are delimited conceptually and spread globally, through a metaphysical and technological subjectivism.

The Carbon Subject(ivism) of the Anthropocene

The carbon atom may be calculated, quantified, transferred, traced and even transformed in nuclear fusion or fission, but it cannot be created nor made by humankind. Rather, it moves only its form and location within the global carbon cycle. This is a natural process. "It is characteristic of all natural processes that they come into being without the help of man," wrote Arendt, "and those things are natural which are not 'made' but grow by themselves into whatever they become" (1998, 150; Heidegger, 1977a, 10). This point bears repeating: Nature cannot be *made* by humans, only altered or transformed. To 'make' is to create an artifact from Nature by doing violence to it; and it then stands always against the eternal recurrence of Nature's processes and cycles. This is the realm of *homo faber*.

Yet, as noted above, scientists in the ESS (and now many IR scholars importing their concepts and frameworks) now confidently assert: "simply, the human enterprise is now a fully coupled, interacting component of the Earth System itself". Natural processes are no longer outside of humanity's reach. Sharing carbon as a substrate, all such processes, such as atmospheric and oceanic circulations, are made equal to "Prominent social processes [such as the] globalization of trade and finance and the rapid increase in communication, especially via the internet" (Steffen et al. 2011, 740; Steffen et al. 2004).

Sharing a conceptual and computerised cabonic physics, therefore, social and economic artifacts are made akin to natural processes, and vice-versa. As Lewis and Maslin have recently highlighted, the realisation of the Anthropocene has now reversed 500 years of

scientific discoveries – from Copernicus decentering the Earth from the cosmos, to Darwin decentering the human species from the Great Chain of Being – each of which moved humans towards an increasing cosmological insignificance, with no special or God-like origin. Rather, if *homo faber* is Nature, and is also therefore able to 'make' Nature, then:

> In the 21st century, adopting the Anthropocene reverses this insignificance: humans are not passive observers of the Earth. *Homo Sapiens* are central because the future of the only place where life is known to exist is being determined by the actions of humans. In fact, we would argue that humanity has become a geological superpower. (Lewis and Maslin 2015b, 112)

In the Anthropocene, as artifacts of humanity are blurred into processes of Nature, and as humans literally become the Earth, calls for "planetary stewardship" become calls to control and govern *ourselves*; scientifically, politically and socioeconomically. If humanity makes Nature and hence makes itself, then "The confrontation with the earth system, its fragility, its capricious grip on life", writes Grove (2015, online), "will irreversibly change what it is to be human".

However, is this not a dangerous assumption that celebrates humanity rather than safeguards Nature? To assume that humanity is made into the Earth system, thereby makes Earth's processes transitory and rectilinear. The Anthropocene, in other words, is thus made into a human artifact: a transitory, uncertain thing. "*Homo faber* is indeed a lord and master" in this sense, wrote Arendt, not only because he may destroy what artifacts he makes, "or has set himself up as the master of all nature, but because he is master of himself" (1998, 144). The point here is that Nature is subjectified, eliciting claims it has been mastered. Subjectification means self-certainty through control. Yet how does this subjectification occur?

With carbon reaching from atomic to global scales, and the socio-economic and the political now made into geophysical processes of Nature, then scientific and

technological rationalities of the Anthropocene place the human subject at the Earth's Archimedean point. "For whatever we do today in physics . . . we always handle nature from a point in the universe outside the earth", although remaining, implicitly, still bound to it through the human condition (Arendt 1998, 262). Hence, Arendt's fondness of quoting Franz Kafka when discussing how modern theoretical and atomic physics relates to human subjectivity and politics today: through Cartesian doubt and its metaphysics, humanity discovered this new rationality by moving "the Archimedean point into man himself, to choose as ultimate point of reference the pattern of the human mind itself, which assures itself of reality and certainty within a framework of mathematical formulas which are its own products" (Arendt 1998, 284). With no way of rendering nuclear and quantum physics into conceivable speech and political action, the human subject is left with *one certainty* amidst this infinite doubt: its own subjectivity. The human, as the maker of Nature.

As Heidegger cautioned, such an insertion of a carbonic human subject(ivity) into every thing and every relation, is the essence of metaphysical subjectivism. In it, human subjectivity as ego or 'I' (*subiectum*), becomes so prominent that it is no longer even noticed as it encompasses the planet, and absorbs itself. When everything in Nature, including humanity's own social and political relations, becomes known only through devices such as GCMs, then 'certainty' can no longer be attained through the senses, or objectively, as object-ivity. Certainty becomes attained only by retreating inwards, into subjectivity. "Man becomes that being upon which all that is, is grounded as regards the manner of its Being and its truth" (1977b, 128).

As noted in chapter 2, Heidegger's metaphysics describe how this form of subjectivism emerged historically, precisely during and through the same socio-political transformations in Newtonian and Cartesian science, Nature, reason, and the modern nation-state, as described by Foucault and Arendt (also see Toulmin 1990). Their accounts are philosophically coeval, and the rise of Cartesian doubt and modernist notions of scale, temporality, and subjectivity are coterminous. It bears repeating once more that the discovery of biopolitical processes, and concepts such as society and

governmentality, emerged only through the background metaphysical transformations undergirding natural sciences and physics as this scientific age dawned. "Metaphysics grounds an age," wrote Heidegger (1977b, 115), "in that through a specific interpretation of what is and through a specific comprehension of truth it gives to that age the basis upon which it is essentially formed".

In today's age of *anthropos*, therefore, what 'is' – facts comprehended as quantified scientific truths processed through computers models – is grounded on mathematical representations of Nature and Earth. The Anthropocene's 'truth' is thus disclosed as it is modeled through simulations of the ESS, and is conceived always and only *in-relation to* humanity or the human subject as its steward. This carbonic subjectivism, in which "Man becomes the relational center of that which is as such", is both extended and concretized through our modern physical and theoretical sciences, that work by challenging-forth and setting-upon Nature, bringing it into being as bounded, measurable, orderable objects. This is the essence of enframing: to reveal all that is, mathematically, so that a subjective world picture forms that is grounded on a calculative self-certainty.

Like processes of data collection in the Anthropocene, this world is no longer what is visually apprehended and discussed socially, as being in our presence, cognized or comprehended from different perspectives. Rather, subjectivity works by re-presenting objects – whether scientific facts or truths, or objects seen in the world – back to itself, to be thought thereafter. To apprehend worldly beings not as presence, but as a re-presented picture to our own selves, is what Heidegger called the *world picture* (1977b).

Through the global spread of this shared metaphysical world picture through Western science, reason, and concepts such as the Anthropocene and ESS, "the more importunately, does the *subiectum* rise up, and all the more impetuously, too, do observation of and teaching about the world change into a doctrine of man, into anthropology" (Heidegger 1977b, 133). Whether it is the quantified fluid dynamics of mathematized carbon at the atomic or the global scale, or the positing of the human

species' limits through planetary boundaries, it is not only that humanity "is set before us, represented to us, in general, but that what is stands before us—in all that belongs to it and all that stands together in it—as a system" (Heidegger 1977b, 129). Indeed, the translation of humanity into data, and its incorporation within the Earth system, is celebrated here: "global observation systems allow scientists to apply *concepts* that were only previously applicable at sub-system, regional or local scale to the Earth as a whole. The Earth itself *is* a system", Steffen et al. exclaim (2004, 3, emphasis original). The point is – through carbon as medium and measure – to merge humanity and Nature together at last. "Science is at the threshold of a potentially profound shift in the perception of the human-environment relationship, operating across humanity as a whole and at the scale of the Earth as a single system" (Steffen et al. 2004, 3). This "profound" shift now manifests itself as a system of *Earth science* touting a homogenized form and understanding of humanity, whilst firmly placing the Archimedean point within humanity itself.

The Anthropocene's world picture is, therefore, not spatial nor visual. In this sense, scholars of contemporary globality focused upon visual images of 'one world' or the 'blue marble' (see Deudney and Mendenhall 2016; Peoples, 2016), miss the point of the Anthropocene's 'world picture'. When we consider how it is possible to 'think' humanity as making nature in this way, the world picture becomes technological and metaphysical; a way of disclosing Nature mathematically as calculable, orderable, and controllable force relations – or, as planetary boundaries. These are processes portrayed objectively and mathematically, but always as a re-presented object 'made' for a human subject(ivity). The world picture is the self, and the self as *Anthropos*: humanity, steward, creator and controller of its own destiny and the planetary boundaries of Nature. The world picture may therefore be atomic, and it may also be global or epochal; but it is always drawn by a subjectivity relating objects back to itself.

For example, in IR this technological subjectivism is explicit in what Biermann (2012, 1306) calls an *Earth system governance* (ESG) framework. ESG "requires fundamental reorientation and restructuring of national and international institutions toward more

effective Earth system governance and planetary stewardship". It demands a new constitutional moment akin to post-World War II transformations, such as formation of the UN or Bretton Woods. To do so, it must also steer the "coevolution" of humanity and Nature by following the same blueprint as planetary boundaries: "the attempt at a quantified suggestion of the boundaries of the earth system that need to be observed in order to maintain the potential for human development and well-being" (2014, 33). Considered metaphysically, therefore, both ESG's call for revised multilateral institutions in accordance with ESS principles, and the calls of critical IR scholarship for an Anthropocene of post-human, post-IR, or radical planet politics (see earlier), share the same conceptual foundation. Despite the noble intentions of all, they ultimately emerge from computerized models of the ESS that bring the Anthropocene into being only by quantifying and projecting Nature within mathematical 'planetary boundaries' to be stewarded by the human subject. Although IR scholars quickly embrace these boundaries, even IAM and GCM modelers declare that, within them, "human agency has been reduced to simplified, rational choice algorithms for the individual level which are applied to the average conditions over a large geographic area" (Verburg et al. 2015, 13). In other words, behind the ESS calculations and ESG prognostications, *anthropos* of the Anthropocene is the rational economic man.

If the way our concepts are formed and bounded thereby delimits what is socially, politically, and normatively thinkable and possible when we enact them (see Beronskoetter 2017; Crist 2013), then scholarship grounded upon quantified computerised simulations risks reinforcing only the possibilities inherent in calculative logics such as rational choice. This world picture thereby perpetuates the same underlying subjectivism that foments the environmental crises of the Anthropocene in the first place. If the Anthropocene and its planetary boundaries are always *already* projected and subjectified to humanity as lord and master of the planet, therefore, then 'how shall the consequence ever attack the ground on which it stands?' (Heidegger 1977b, 140).

Relationality: *Anthropos* as the Measure of All Things

If we are presently caught in an intensifying subjectivist and technological rationality, then how is it possible to escape, or to think differently? Can politics or international relations be retrieved from its current projection of carbon at subjective and objective scales? What aims or research agenda might IR or global environmental politics pursue in the future? There remains to be explored the essence of thought as it is evinced through the Anthropocene's technological subjectivism: *relationality*.

Relationality describes the current mentality that is manifested through the physics of the ESS and in the overarching concept of the Anthropocene. Orienting subjectivity, it is what governs or conducts conduct thought the concept of this human epoch. In it, every referent object is projected and experienced as a measurable and calculable relation to subjectivity. No object is static, existing in-itself, or existing in the 'metaphysics of presence' that was existed prior to the Cartesian Moment. Rather, every thinkable referent is now 'pictured' by the mind and re-presented back to the subject, with the human made into its fulcrum or reference point. In other words, everything in our world picture is thus represented and made thinkable only as a subject-object relation dependent upon human agency. For example, a jet aircraft on a runway is no longer cognized or thought of as an object giving flight; it is only thought of as a fleeting relation to a human subject's next destination, next meal, next meeting, next drink, next deadline, next flight, and so on. In this relationality, objects are replaced by the uncertainty of future human relations. And in the Anthropocene, a subject's relation to climate change, the Earth, carbon, water, one's daily carbon footprint, etc., all become fleeting relations of a human's own potential impact upon a future they may never actually experience. Every 'thing' becomes an uncertain relation, reflected back to oneself.

Once everything becomes only this implicit relation to everything else, the object itself – whether it is Earth, the carbon atom, or the supposed quantum entanglement of all life – actually disappears. When speech is replaced "by the extreme and in itself meaningless

formalism of mathematical signs" (Arendt 2006, 274), and when the objective world is no longer graspable by human senses, then certainty falls back upon the 'I'. Humanity as the subject's self-certainty is all that remains to grasp or assert.

Heidegger (1977b, 135) calls this the "gigantic" – a rationality that is simultaneously so large and so small, that in its tendency to calculate everything at every space and scale, it moves beyond objects and the "purely quantitative", the temporally uncertain, and the "Americanism" of globalisation, to become "precisely through this, incalculable" (1977b, 135). The 'I' of the human reemerges as a 'We' of homogenized thought. We, as a subjectivised humanity, Nature, and Earth system. "Man as a rational being of the age of Enlightenment is no less subject than is man who grasps himself as a nation, wills himself as a people, fosters himself as a race, and, finally, empowers himself as lord of the earth", wrote Heidegger (1977b, 152). In this case, it is humanity as a global mass of carbon, leaving stratigraphic scars lasting eternity; and it is simultaneously one's own carbon footprint, as they take their recycling to the curb of their home for collection by their local municipality. "In the planetary imperialism of technologically organized man, the subjectivism of man attains its acme, from which point it will descend to the level of organized uniformity and there firmly establish itself" (1977b, 152). Precisely how this metaphysical (Earth) system of relationality operates, the ways that Nature remains correlative with science and political rationalities flowing through it, and how its intensifying subjectivism will transform or spread globally through such technological infrastructures as carbon, GCMs, IAMs, and other concepts and simulations (Edwards, 2010; 2012), remains to be explored. In starting along this path, this thesis hopes to contribute towards future research in IR and the social sciences going forth.

Chapter 7 and chapter 8 of this thesis will now engage two components of this relationality as it has emerged, and is expressed, today: temporally, in which humanity reflects itself as a 'we' of the human species projected into deep time; and in terms of security discourses of 'entanglement', where the mathematical complexities of quantum science serve to reflect human subjectivity back upon itself.

Conclusion

This chapter has traced how the Anthropocene emerged from the problematique, practice, and rationality, of climatic globality. It argued that the Anthropocene is not a concept that can be implanted from the ESS and simply applied to IR or the social sciences. It is not a governmental medium for (neo)liberal economic strategy, nor is it comprised of sovereign, disciplinary or even governmental forms of power. It is not the pinnacle of *homo faber's* making of Nature as steward and master of the Earth, nor does it herald a transformation of the human condition as an entangled part of Nature. At its conceptual foundation, the Anthropocene celebrates and reifies the human subject. It privileges and sees carbon, the atom of life and the substrate of humanity, everywhere. The 'making' of nature occurs only at the level of atomic carbon, which echo today in GCMs and ESS models. As carbon is quantified and congealed into planetary boundaries, ESS projects a type of rational economic man instructed to work within these thresholds to safeguard life, Nature, and itself – the 'human enterprise'.

This chapter has also illustrated the emergence of an implicit rationality that undergirds the globality of climate change and the Anthropocene: a technological and metaphysical subjectivism. This 'relationality' fosters neither reflection nor humility. Instead, it responds to the processes of a science and theoretical physics too complex to conceive by the human mind, by projecting the human species as the Archimedean point of Being, the master of Earth, *Anthropos*; the maker and the measure of all things. This is a specific type of human relation to Being, Nature, Earth, and life, conceived now an excess of carbon and an excess of biopower. Humanity is tracing Nature, carbon, and itself, from the atom to the global cycle, seeking to fulfill its destiny by controlling geological space and time. This gives the impression of a human subject that is simultaneously individual and total; atomic and global; saving and destroying; the past and the future; the egoistic I, and the homogenized We.

If biopolitics is considered as life being imbricated and used within political strategies, then researching the Anthropocene as an excess of carbonic biopower opens new

possibilities for research in IR. It is a new global biopolitics of carbon, in which everything – including temporality, uncertainty, Nature, and the other artifacts 'made' by a finite and mortal *homo faber* – becomes absorbed in the gigantic. *Anthropos*, always and everywhere seeing itself, as maker of Nature and hence the steward and destiny of Earth.

It thus behooves IR to analyze the dangers and effects of the Anthropocene's subjectivism; that the human

> …as the one so threatened, exalts himself to the posture of lord of the earth. In this way the impression comes to prevail that everything man encounters exists only insofar as it is his construct. This illusion gives rise to one final delusion: It seems as though man everywhere and always encounters only himself. (Heidegger 1977, 27)

Everywhere, this relationality posits atomic and global human relations, upon relations, upon relations, *ad infinitum*.

In the remainder of this thesis, the themes of Anthropocene temporality, security, and entanglement, will now be explored through the emergent concept of the Anthropocene, and its inherent technological subjectivism of relationality.

Chapter 7 – Temporality and the Anthropocene: Foucault's End of History

Introduction

The aim of this chapter is to explore the temporal implications of the Anthropocene. Upon analysis, this concept moves far beyond the days, months, and years of clock or 'human time' that frames the everyday background of IR and the social sciences. The Anthropocene spans geologic epochs and multi-million year timescales known as 'deep time'. This vast timescale has been foreign or extraneous to discourses of IR and the social sciences, until now (see Hutchings 2008; Harrington 2016). As such, the recent admission of Anthropocene discourses into IR contains implicit temporal and conceptual limitations and possibilities that have not yet been considered. This chapter fills this gap by exposing how the Anthropocene's notion of deep time contradicts and transforms the human time of IR and governmentality analytics.

This chapter argues that the concept of the Anthropocene implies a new understanding of time and temporality that 'ends' history as it is currently perceived in disciplines such as IR. It arrives at this conclusion by following Foucault's governmentality lectures of 1977-1978, in which he describes our modern sense of time as an "indefinite governmentality of the state" (2007, 356). According to Foucault, this modern governmentality will eventually be confronted by "a final time", in which the history, politics, and the indefinite governmentality of everyday statist time, comes to an end (Foucault 2007, 356). If we analyse the concept of the Anthropocene through this lens of governmentality, then it indeed points to the end of history as such. In this human-epoch, the indefinite time of liberal statist governmentality that was grounded upon globally adopted norms of Western clock and calendrical time (see Hom 2010), must be replaced by a new form of geologic and deep time. When thinking in terms of geologic epochs, the days and years through which politics and international relations has always occurred, become irrelevant; a mere beat in the heart of Anthropocene time. This

transition to deep time not only transforms history, therefore, but how humanity is able to conceive of itself and to place itself within Earth history, and the universe: its cosmology.

This takes us to the second argument of this chapter. Based upon the relationality identified in chapter 6, the Anthropocene asserts a new cosmological place for humanity in the cosmos by returning the human subject to the 'centre' of all spacetime. Whilst the birth of Christ previously functioned as the primary temporal dividing line or marker for (Western) human history, and for the "indefinite governmentality" of modern politics, this event is copied and replicated anew in the Anthropocene's golden spike. Historically, clock or human time was based on the birth of Christ serving as what Arendt (2006) described as a marker for a twopoint infinity of past and future. The Anthropocene replaces this divine marker with its own *human-made* carbonic scar, as a new twopoint infinity of *anthropos*: the golden spike GSSP, or the new origin story marking the Anthropocene's global stratographic signature across the entire Earth. In doing so, the Anthropocene's temporality re-governs the cosmological and temporal order by ending human history, replacing it with the deep history of a geologic yet re-humanised time. This new twopoint infinity is engendered by the human species, rather than by a divinity or the Earth's geology. The state's indefinite time of governmentality is thereby replaced by relationality; a temporality of deep Anthropocene time. With years dissolved into epochs, the liberal individual no longer gains certainty from its individualism or 'I', but must now derive certainty from a concept of humanity stretching across epochs, as a collective species (Chakrabarty 2009).

This chapter makes this argument in four steps. First, it provides a short overview of Foucault's cosmology of government. For Foucault and Arendt, the birth of Christ, and the chronological sequencing within deep time stemming from this event, resulted in what Foucault called the de-governmentalization of the cosmos. What the Anthropocene implies by returning humanity to the centre of Earthly Being, therefore, is a re-governmentalization of the cosmos. Second, the chapter defines and clarifies the concepts of deep time and geologic epochs, in accordance with the Geological Time

Scale (GTS) of geological and stratigraphic sciences. Contrasting deep time with human time will thereby illustrate the profound paradigm shift, or transformation in underlying political rationalities, that is demanded in thinking and recognising the concept of the Anthropocene. Third, the chapter will review Foucault's own discussion of time and the 'end of history' from his Collège de France lectures of 1977-1978. Foucault claimed that statist governmentality facilitates a sense of temporal stasis, or an indefinite time and atemporality, of history. Yet, this was a human history that could also end. How? This leads to the final component of this chapter, which returns to the Anthropocene's glorification of deep time as the re-governmentalization of the cosmos. It concludes that clock or human time is conceptually irreconcilable with the vastness of a geologic epoch. Hence, if IR is to embrace the concept of the Anthropocene as its adherents insist, then it must also implicitly discard the cosmological and temporal underpinnings of our modern "indefinite governmentality" and the state, so as to end history.

The Governing of the Cosmos

Prior to defining what discourses of the Anthropocene mean by 'deep time', we must first review what Foucault described as cosmological governance. Although rarely mentioned by Foucault, his depiction of a "de-governmentalized cosmos" (2007, 236) is what underpins common assumptions today concerning human time, deep time, and modern statist governmentalities. Contrary to this de-governmentalized cosmos, what is contained within the concept of the Anthropocene and its golden spike is a *re-governmentalized* cosmos. What is meant by these terms?

Throughout his 1977-1978 lecture series at the Collège de France, Foucault (2007) repeatedly describes pre-modern conceptions of Nature, Being, and time, and how these underpin modern forms of government. Prior to the emergence of governmental rationalities in the seventeenth and eighteenth centuries, Foucault places the human subject within an "historical-religious sovereignty" because preceding the "political government of men" came "the pastoral of souls" (2007, 228). Indeed, the concept of pastoral power is perhaps the best known of these forms of power.

However, Foucault has much more to say about the role cosmology played in shaping forms of power. Prior to the seventeenth century, he claims that sovereign princes and kings were still subject to "those two great poles of the Empire and the Church that represented a sort of great spiritual and temporal pastorate" (2007, 229). These existed in a cosmological order that "dominated the West and promised salvation, unity, and the fulfillment of time", within a Nature governed by Divine power (Foucault 2007, 229). In this cosmos governed by a pastoral God, therefore, the territorial sovereign thereby governed according to Nature. This Nature was, in turn, *divine*; God *was* Nature. "Insofar as he governs, the sovereign does nothing other than reproduce a model [that] is quite simply that of God's government on Earth" (2007, 233). This Earth, therefore, was an "anthropocentric world" governed from the divine, to the sovereign, to humanity (2007, 236).

Surprisingly, Foucault stressed that there was, *at first,* no cosmological nor eschatological break in the transition from sovereign to governmental rationality. "There is no break therefore. This great continuum from sovereignty to government is nothing else but the translation of the continuum from God to men in the—in inverted commas—'political' order" (Foucault 2007, 234). Why no break? Just as the cosmological transformation engendered by Copernicus still retained the human being of Christian faith as its center and grounds (Arendt 2006), Foucault likewise notes how the transition from sovereignty to government in the Cartesian moment (see chapter 2) retained a similar cosmological and theological perspective. The anthropocentric world's "theological-cosmological continuum in the name of which the sovereign is authorized to govern and which provides models in accordance with which he must govern", thus continues on into early statist models of governmental rationality (2007, 234). Although the Earth was de-centered from the cosmos, the human being was not.

The purpose of the scientific practices of Copernicus, Kepler, Galileo, the Port Royal grammar, etc., "was to show that ultimately God only rules the world through general, immutable, and [scientific] universal laws" (2007, 234). Although there was a

bifurcation of religion and science here, their shared theological continuum bends, but does not break. For instance, Hobbes produced *Leviathan* based on secular Natural Laws, but he still died in mortal fear of "hell-fire"; Descartes produced a metaphysics of subjectivism (see chapter 2), yet he still "prayed to the Holy Virgin"; and Grotius quipped that "even God cannot cause two times two not to make four" (quoted in Arendt 2006, 70), because he was searching for Natural Laws that not even divine intervention could alter. Each scholar, therefore, developed a philosophy operating in accordance with secular Natural Law, whilst retaining the "theological-cosmological continuum" of divine temporality within their own personal conduct. Ultimately, this remained a governmentalized cosmos.

This brings us to a crucial transformation in temporal and political rationalities. It occurred through, and concurrently with, the application of Enlightenment sciences and geological timescales to politics. In the late-seventeenth century, these began to displace divine power from its cosmological role. Now, Nature increasingly became "laid out in terms of mathematical or classificatory forms of intelligibility" (Foucault 2007, 236) that no longer passed through the envelope of the human being. No longer did God govern nor reign over the world through scientific principles (2007, 235). Rather, Foucault notes that, as government and *raison D'Etat* replaced the pastoral government of divine Nature, the connection between politics and Christian eschatology and cosmology was similarly displaced. As physics and Western Enlightenment sciences isolated humanity from divinity, a "de-governmentalization of the cosmos" occurred (2007, 236). As will be discussed below, only through this de-governmentalization could historical science, clock time, and "modern governmentality and historical science", then emerge by supplanting divine order (2007, 355). Models for a governmentality of the state could emerge *only after* models conceived as the divine governance of the cosmos, dissolved. Indeed, according to Northcott (2016), this de-governmentalization reached its apex in the discovery of geological deep time, which shattered this outmoded theoretical-cosmological continuum by illustrating the sheer vastness of planetary time. No longer could God's reign, or the 6,000 years of the Genesis 1 narrative, be channeled through sovereign power and scientific principles to

secure humanity's place. In deep time, humanity could no longer be located at the centre of the Earth's genesis, nor of the cosmos; the human subject became a mere blip, or as the saying goes, a grain of sand on an infinite beach. In awakening to its place as this de-governed blip, the human being was now left to govern itself. As reviewed in chapter 2, this is also the moment when self-certainty through the Cartesian 'I' becomes fully entrenched. Rather than being certain of the Church doctrine's placing of all Earthly creation within a Great Chain of Being, "the freeing of man to freedom as the self-determination that is certain of itself", subjectivity – as calculative thought – emerges (Heidegger 1977b, 148).

Foucault's subtle point here is that the cosmos is always governed in some way or another. The de-governmentalization of the cosmos thus facilitated the governmentalization of the state, and the forms of modern governmentality and calculation that we in IR and the social sciences take for granted today. This event occurred through a specific cosmological orientation, spurred on by the de-centering of humanity's influence on Earth, best crystallised and articulated by the discovery of geological and deep time. Today, however, with the 'discovery' of the Anthropocene's golden spike being celebrated in IR and the natural sciences, a new such cosmological order is being set forth. As will now be argued, it is a cosmology that re-governmentalizes the cosmos, but not by placing a God nor a divinity as the ultimate sovereign power. Instead, it magnifies and intensifies the self-certainty of human subjectivity by asserting humanity as the most dominant geophysical and geological force of Nature.

Prior to interpreting the cosmological implications of the Anthropocene, however, this chapter now turns to deep time, geologic epochs, and the Anthropocene's golden spike.

Deep Time: Geological Epochs and the De-Centering of Humanity

Time is often introduced to readers in IR through St. Augustine's pithy summary of time in his *Confessions*, which remains apposite for us today. "What then, is time?" St.

Augustine asked. "…if no one asks me, I know; if I wish to explain it to one that asketh, I know not" (taken from Stockdale 2016, 1). Although time underpins our everyday experience and Being in the world, it presents unique difficulties to scientists and philosophers alike, because it is ultimately a subjective inference: "We create a concept of external, non-personal time by analogy, by imposing an order, a constructed memory, on the evidence of external events" (Burchfield 1998, 137). This means that every objective classification and inter-subjective or social concept of time, are neither universal nor innate: "geological time, like historical time, lies forever outside the scope of our direct experience, [and is] an artefact. It had to be created or invented" (1998, 137). Our everyday understanding of time can change. Temporality itself is a social practice.

To claim that the Anthropocene ushers in a new geological epoch is to make a *temporal* claim referring to deep time (Dear 2016). 'Deep time' has a special name because it refers to the vast timescales of the Earth's past, or geologic time. Geologic timescales are so large that they are literally incomprehensible to the human mind (Burchfield 1998). For instance, to say that the Earth has existed for 4.5 billion years, is to refer to geologic, or deep time. This timescale far exceeds what we would ordinarily call 'human time', which refers to our subjective everyday experience and familiarity with linear chronologies of seconds, minutes, hours, days, months, years, and decades. This chronotic time "renders life manageable, by providing a background frame in relation to which we can measure phenomena such as the length of the working day, the span of human life, or the duration of empires" (Hutchings 2008, 5). Indeed, in this chronological cosmological order of human time, the present is qualitatively the same as the past, and the future. All operate in accordance with a mechanistic or calendrical clock time (Hom 2010). In clock and human time, we build our lives and our worlds.

Politics and international relations occur in human time. Hence, with the emergence of the Anthropocene and deep time, difficulties arise not only spatially, but temporally. As noted by Harrington, "The timeframe of the Anthropocene is indeed nothing more than a blink in geologic time, but trying to construct a political response for a cumulative series

of events over the course of a century, let alone a millennia, is a tall task indeed" (Harrington 2015, 495). Despite the importance of this task, IR has still not engaged nor grasped the full ramifications of this geologic or deep time for the conceptual foundations upon which the discipline is built. Embracing the Anthropocene demands a transformation of the subjective constructions of human time and temporality, to a deep time that IR has not prepared for.

What exactly is deep time? Deep time is an historically complex concept referring to the multimillion-year age of the Earth and the universe. It emerged through a series of scientific advancements from the seventeenth to nineteenth centuries. This chapter now follows Northcott's recent account (2016) of 'deep time' as first making an official appearance in scientific discourses when it was presented to the Royal Society of Edinburgh in 1785, by Scottish geologist James Hutton.

Working simultaneously as a farmer and a mineralogist, Hutton came to the conclusion that rocks were not universal nor innate objects brought directly into being by God in accordance with the Bible's Genesis 1 narrative. Studying the mix of veins of granite and sedimentary rock on his farms, and interpreting the unique sedimentary constellations or 'unconformities' of twisting sedimentary rock patterns visible at Siccar Point on the coast of Edinburgh, Hutton theorised that these layers of rock strata formed through a different process than accepted narratives of divine creation. The formation of a stratum was framed as a process, beginning when rainfall eroded layers of soil and minerals that were carried to the ocean through streams and rivers, and were then put under tremendous pressure, compacted by the weight of the ocean. Stratum also combined with the cooling of magma that had erupted from the inner core of the Earth, to form layers of sedimentary rock strata (Northcott 2016).

In Foucauldian terms, Hutton now put forth a type of counter-conduct – a different rationality or style of thinking – to that of pre-modern theological eschatology and cosmology. "Hutton argued that only a vastly deep temporal history could have achieved the present state of which he could 'find no vestige of a beginning, no prospect

of an end'" (Northcott 2016, 100; Burchfield 1998, 137). This theory was contrary to both the science of the time, and the accepted theological accounts from Genesis asserting that the Earth was approximately 6,000 years old. Yet only from out of this new notion of deep time, was the geologist Charles Lyell and biologist Charles Darwin able to create and to expand upon it, through their own geologic and evolutionary theories (Burchfield 1998). In short, Hutton's theory was unprecedented, in that it illustrated a new geological and Earthly timescale that had created Earth and Nature through geologic processes, and not a divine creator god governing humanity.

The cosmological transformation engendered by the discovery of this newfound geological or deep time is difficult to overstate. For Northcott (and Arendt, 2006), Hutton's deep time had a greater and more significant impact on Western religious, cosmological, and sociopolitical imaginaries, than even Copernicus's argument that the Earth was at the centre of the universe. As noted above, whilst Copernicus had opposed the Ptolemaic cosmology supporting religious authority, he "did not challenge humanity's central place in Earth's history. Christian chronology from the second century of the Christian era had mapped human intergenerational history onto Earth history with only slight variations in calendric enumeration for more than 1,500 years before Hutton" (Northcott 2016, 101). After Hutton, however, through geological deep time, the centrality of humanity to the cosmos is eroded (see Toulmin 1990). The "history of the Earth is divided into a much longer set of eras that had nothing to do with God, Christ or humanity, and which extend back over roughly four billion years" (Northcott 2016, 102). This is the emergence of the 'human time' or historical time with which we in IR are today familiar with today (Hom 2010). Through this event, the duration, magnitude, and "diversity of the successive periods of life revealed by the fossils it [rock layers] contained produced an inescapable impression of vistas of time stretching far beyond the scope of human history" (Burchfield 1998, 139).

Why is it important here to recall the displacement of humanity from eschatological and cosmological order that occurred with the invention of deep and geologic time? First, the BC/AD two-era chronology that scaffolds and supports today's everyday notions of

human time, dates from Hutton's scientific intervention into eschatology. It remains today "so influential that it is represented in astronomical clocks, digital computers, and printed and online encyclopedias and history books" (Northcott 2016, 102). Whilst 'Before Christ' and 'Anno Domini' remain, their underlying nomenclature has shifted as BC became secularised as BCE (Before Common Era). Yet despite its present secularisation, the fulcrum of this twopoint infinity into past and future remains that of Christ's birth.

Second, this discovery of deep time was not merely an historical or scientific exercise, but a political event. It fostered a transformation in political rationality that Foucault credits as the catalyst and foundation for today's modern or "indefinite governmentality" (see chapter 2 for an account of the scientific processes emerging at this time, and how they delimited objects of society and population). It is thus to Foucault, and his positing of this indefinite governmentality as constitutive of our sense of time and history, that this chapter turns.

Foucault's Indefinite Governmentality and the End of History

It is now common to read in IR that scholars have long made the 'space' for discussions of spatiality, but have not made the 'time' for temporality (see Hutchings 2007, 2008; Hom 2010; Hom et al. 2016; Stockdale 2015). With the emergence of the Anthropocene's notion of globality, however, time is now placed at the forefront of discussion (Harrington 2015). A transforming Earth system renders the concept of an atemporal international system, or permanent state structure, akin to "the visible hands of a watch running down" (Burke et al. 2015, 510). Rather than cling to outmoded concepts of states and international systems, therefore, we read that the Anthropocene re-imagines "our entire structure of social-political time. This time is both much longer than our contemporary horizons, taking in hundreds and thousands of years, and much shorter, requiring ameliorative action that should have begun yesterday" (Burke et al. 2015, 510).

What are the ramifications or implications of this Anthropocene temporality to human time and history? Here, we may return to a comment made by Foucault at the conclusion of his famous 1977-1978 lectures at the Collège de France. In his final lecture on 05 April, 1978, Foucault made a direct reference to human time, history, and governmentality. This reference has (surprisingly) remained unexamined in IR, despite the discipline's recent 'temporal turn' (see Agathangelou and Killian 2016; Hom et al. 2016). To quote Foucault, as he was summarising his lecture series of that year: "More schematically, and to summarize all that I have wanted to say, maybe we could say that *raison d'Etat* basically posited as the primary, implacable law of both modern governmentality and historical science that man henceforth has to live in an indefinite time" (2007, 355). By 'indefinite', he was referring to notions of stasis, and political and governmental constancy as *atemporality*: a perpetual time in which governed citizens tacitly assume that the state and its institutions "will always be there, and there is no hope of having done with it [the state]" (2007, 355).

This indefinite time is what scholars have long noted is the 'background context' for both IR (Hutchings 2008), and discourses of the Anthropocene (Harrington 2015). As Hom (2010, 1151) has written, this "Enlightenment epistemology correlated conceptually with the emergence of the doctrine of *raison d'etat*, which lent legitimacy to discrete, autonomous territorial rule by substituting state interests for dynastic interests". Statist governmentality thereby replaced the top-down forms of divine rule governing the cosmos. However, Foucault also raises the possibility that this modern, indefinite time – *our* indefinite time of modern governmentality and history – can *end*. How? According to Foucault, this would require a new form of counter-conduct, to

> … make it a principle to assert the coming of a time when time will end, and to posit the possibility of an eschatology, of a final time, of a suspension or completion of historical and political time when, if you like, the indefinite governmentality of the state will be brought to an end and halted. By what? Well, by the emergence of something that will be society itself. The day when civil society can free itself of the constraints

> and controls of the state, when the power of the state can finally be reabsorbed into this civil society— . . . *time, the time if not of history then at least of politics, of the state, will come to an end* as a result.
>
> (Foucault 2007, 356, emphasis added)

In other words, if our indefinite governmentality is comprised of one specific temporal form of rationality and practice, then it may also be replaced by other forms. Just as geologic time was a form of counter-conduct to the divine time of a governed cosmos, so a new form of conduct and rationality could transform our own naturalised rationality of politics, history, *and* time. If a new social practice and rationality emerges as a counter-conduct that subsumes the state, then a re-governmentalization of the cosmos should occur as well. The modern time consciousness through which we live our everyday life is, ironically, transitory.

Foucault's brief mention of ending time and history should sound familiar to IR scholars. Although broaching the subject in terms of governmentality, he is indeed referring to the concept of the 'end of history'. Not, however, to IR's familiar trope of Francis Fukuyama's oft-cited piece in *The National Interest*, that posits the End of History as the inevitable "end point of mankind's ideological evolution and the universalization of Western liberal democracy as the final form of human government" (1989). Instead, Foucault is harkening back to the emergence of deep time and how its discovery made this modern and statist form of governmentality possible. Since this is highlighted in the final summary lecture of his 1977-1978 lecture series, his comments on temporality should not be discounted or ignored. Rather, here, Foucault is pointing out that our modern understanding of government is "indefinite", because of the cosmological transformations previously catalysed by Hutton's geological displacement of divine and eschatological time. The twopoint infinity of BC/AD allows for both the indefiniteness of state governmentality, and for human time.

Prior to arguing that the Anthropocene's global biopolitics of carbon implies the end of this indefinite time and history (see chapter 6), this chapter must first outline the

cosmological marker that it replaces: the orienting of human time through a twopoint infinity of past and future.

A Point in Time: Marking an Indefinite Past from an Indefinite Future

It is crucial to note that the emergence of this 'indefinite time' and its de-governmentalized cosmos is also what Arendt identified as the birth of our modern time consciousness. It is in stark contrast to "the Christian notion that mankind has a beginning and an end, that the world was created in time and will ultimately perish" (Arendt 2006, 67). Likewise, it is against the notion of divine governance working through Nature's laws. Rather than a Christian narrative of beginning and end, our modern chronological notion of time and history depends on a specific point, or marker: "the modern computation of historical dates, introduced only at the end of the eighteenth century, that takes the birth of Christ as a turning point from which to count time both backward and forward" (Arendt 2006, 67).

Why is this moment so important? Arendt stresses that what is new is neither the calendric nor chronological enumeration of time (accomplished by the Jews in the Middle Ages), nor when Dionysus Exiguus began counting time from the birth of Christ in the sixth century (2006, 67). Rather, this new BC/AD system was something far beyond a mere technical improvement "needed for scholarly purposes to facilitate the exact fixing of dates in ancient history without referring to a maze of different time-reckonings" (2006, 67). It is now through the BC/AD of an endless deep and geological time, that

> for the first time, the history of mankind reaches back into an infinite past to which we can add at will and into which we can inquire further as it stretches ahead into an infinite future. This twofold infinity of past and future eliminates all notions of beginning and end, establishing mankind in a potential earthly immortality. . . . So far as secular history is concerned we live in a process which knows no beginning and no end

> and which thus does not permit us to entertain eschatological expectations. (Arendt 2006, 68)

No longer governed by God, Nature (and the state) then become fixed to a new concept that explains the movements and workings of both, in accordance with the Enlightenment science taking hold: scientific processes.[1] As Foucault noted, "We are dealing with processes that can be known by methods of the same type as any scientific knowledge" (2007, 350). These processes may also be indefinite, occurring over geologic periods of time. Now freed from eschatological and theological narratives that contradicted notions of indefinite processes, scientists such as Lyell and Darwin could then conceive of "the Earth as presently constituted as a living 'Earth system' which has been uniformly created, and is still being created, by living processes which over long time periods change its appearance and constituent parts" (Northcott 2016, 101). As noted in chapter 2, it was also through the emergence of these scientific processes that population arithmetic – statistics – was able to divulge the processes comprising a state's population, thereby revealing biopolitical patterns of a society, implying how best to govern them. Hence, the emergence of statist governmentality and deep geological time, through the discovery of this twopoint infinity of past and future. The de-governmentalized cosmos becomes one comprised of indefinite processes.

Not only does this de-governmentalization of the cosmos through the BC/AD marker of deep time orient the time consciousness of statist and 'indefinite governmentality', but it fostered the rise of thinking about life in terms of 'species'. After Hutton, "The dimension in which the population is immersed amongst the other living beings appears and is sanctioned when, for the first time, men are no longer called 'mankind (*le genre*

[1] Consistent with chapter 6's critique of the Anthropocene's concept of making Nature, it must be noted here that Arendt (as well as philosophers such as Marx, and historians such as Vico) cautioned long ago that human history itself became worthy of study only when it could be conceived of as a process made by humanity. With a de-governmentalised cosmos, if Nature extends into an infinite geological timescale of past and future, then 'mankind' can truly 'know' only what it 'makes' itself. As both Foucault and Arendt note, a paradox arises here: if history becomes a process made by humanity, then there must also come a point in time when this fabrication process itself must end. "[If] one takes history to be the object or a process of fabrication or making, there must come a moment when this 'object' is completed, . . . one cannot escape the consequence that there will be an end to history" (Arendt 2006, 79; Foucault 2007, 253).

humaine)' and begin to be called 'the human species'" (Foucault 2007, 75). Why? When considered in deep and geologic time, an individual biological agent cannot be recognised on such a vast timescale. As noted above, a single human life loses the immortality granted to it through Christian eschatology. Again, the human being becomes one beat in the infinite heart of time. Hence, as one of the most prominent German historians of the time remarked: "What their species is for animals and plants . . . that is history for human beings" (J. Droysen, quoted in Arendt 2006, 75).

As will be argued below, the transformation of human history into an understanding of species is what is implied, and even demanded, in the Anthropocene's concept of temporality. "In it most radical form, the long-term perspective also brings human history in dialogue with the deep time of geophysical events and planetary tipping points" (van Munster and Sylvest 2016, 10). Yet the recognition of globality in terms of planetary tipping points ranging over geologic scales demands the eschewing of individual human lifespans. The only way to think of the Anthropocene's temporality and human agency, therefore, is thus to reconceptualise human agency at the level of a collective species: "We may not experience ourselves as a geological agent, but we appear to have become one at the level of species" (Chakrabarty 2009, 221). Although an individual human can never experience the deep time of the Anthropocene, the human species can. For Chakrabarty (2009, 221), "We experience specific effects of the [Anthropocene] crisis but not the whole phenomenon." The whole phenomenon, if it is to be experienced, is at the timescale of the 'we' of the species.

If this collective 'we' of the species depends on a moment or marker that upsets or resets the BC/AD marker of Christ, where might this marker be found? This chapter will now argue that the end of human time and history demanded by the Anthropocene emerges through its concept of a geologic GSSP, the 'golden spike'.

What *is* a golden spike?

In order to discuss the temporal significance of the Anthropocene's golden spike, we must first define it, and why it is relevant within geology and stratigraphy. Although this section is somewhat technical, readers should bear in mind that it also situates part of the argument of chapter 8. Without defining the basics underpinning the golden spike, not only is it difficult to make an argument concerning the concept of the Anthropocene, but there is no such thing as an Anthropocene epoch at all.

Stratigraphy is "the most fundamental endeavor in geology", and it has been "forever intertwined" with geological time (Aubry et al. 2000, 203). It is essential to the concept of the Anthropocene because it is what places the human epoch within the context of Earth history (Zalasiewicz et al. 2010). In general terms, 'stratum' refers to a horizontal layer of rock. This layer is the end of a process millions of years in the making, in which tiny pieces of rock called 'sediment' are eroded from soils on land, and slowly washed into lakes and oceans from the currents and flows of rivers and waterways. As sediment is slowly deposited on the floor of large water bodies, over long periods of geologic (deep) time, it is compacted by the pressure of the water into a stratigraphic layer of sedimentary rock. As different layers of sedimentary rock form on top of one another over millions of years, distinct stratigraphic layers or sections – strata – are formed. As Hutton discovered in 1785 (see above), these stratigraphic sections can be identified, studied, traced, and their geological age within a 'deep' time of millions or even billions of years, revealed (Burchfield 1998).

Presently, a 'Working Group on the Anthropocene' at the Subcommission on Quaternary Stratigraphy, in London, UK, is deliberating over whether the Anthropocene is officially its own geologic epoch. If so, it must, therefore, be a formally recognised unit in the Geological Time Scale (GTS). The GTS is divided into a complex and hierarchical series of increasingly-detailed units, and operates as follows: we are presently residing in "the Holocene epoch (Greek for 'entirely recent'; started 11,650 BP [before present]), within the Quaternary Period (started 2.588 million years ago),

within the Cenozoic Era ('recent life'; started 66 million years ago), of the Phanerozoic Eon ('revealed life'; started 541 million years ago)" (Lewis and Maslin 2015, 172).

For the scientists and geologists involved in this process, this is a serious endeavor and decision, and the stakes are high for stratigraphic disciplines and the science of geology more generally (Barry and Maslin 2016). The International Commission on Stratigraphy (ICS) is one of the oldest and largest bodies in the geological sciences (ICS 2012), and its "primary objective is to precisely define global units (systems, series, and stages) of the International Chronostratigraphic Chart that, in turn, are the basis for the units (periods, epochs, and age) of the International Geologic Time Scale" (ICS 2017, online). In other words, the ICS sets the global standards for expressing the history of the Earth. To designate an Anthropocene epoch would be unprecedented, in that this designation hinges upon whether humanity's impact on the planet is substantial enough so as to warrant the re-designation of the human species itself, as mineralogical rock strata: "If humans now author the rocks, atmosphere and oceans with anthropogenic signatures, then the inhuman (as nature, earth, geology) becomes decidedly changed as a category of differentiation" (Yusoff 2016, 6).

In general, two strange circumstances currently prevent the Anthropocene's recognition as its own geologic epoch: first, all previously designated geological units and timescales have long since terminated thousands and millions of years ago, but the Anthropocene is ongoing; we are living *in it*. Secondly – and most importantly – "however these debates will unfold, the Anthropocene represents a new phase in the history of both humankind and of the Earth, when natural forces and human forces became intertwined, so that the fate of one determines the fate of the other" (Zalasiewicz et al. 2010, 2231). In other words, in contrast with Hutton's 1785 theory of deep time, the Anthropocene's official scientific and geological designation would actually *reunite* humanity with the cosmos.

As noted in chapter 6, there is currently a heated debate surrounding when the Anthropocene supposedly began, and hence what event or marker could officially

designate the onset of this geologic epoch. Divisions in the geologic time scale must represent this global stratographic layer and corresponding change(s) in the functioning of the Earth as a system, and hence, in "concomitant changes in the resident life-forms". This occurs by identifying a beginning boundary, marker, or point: a Global Standard Stratotype-Section and Point (GSSP), commonly called *a golden spike* (Lewis and Maslin 2015, 172; Barry and Maslin 2016; Aubry et al. 2000). "Defining the beginning of the Anthropocene as a formal geologic unit of time requires the location of a global marker of an event in stratigraphic material, such as rock, sediment, or glacier ice, . . . indicating changes to the Earth system" (Lewis and Maslin 2015, 173). Despite its importance, IR scholars importing the concept of the Anthropocene have not paid much attention to the golden spike. Although Harrington (2015, 483) does note the decision of the ICS concerning whether or not to designate the Anthropocene as an epoch, the golden spike itself becomes secondary in his account to more explicitly "political questions about its start date and who is actually responsible for its emergence". True, if "man is understood as an undifferentiated trace in the strata" (Yusoff 2016, 6), this ubiquitous global trace masks issues of race, class, gender, geography, development, etc., that are essential components of politics. Ultimately, however, the temporal significance of the golden spike itself, as a concept, again goes unacknowledged. It is treated as an innocuous or neutral scientific practice.

Earth system scientist Clive Hamilton has rejected popular accounts, such as that of Lewis and Maslin (2015), as a "golden spike fetish" based on a "misplaced preoccupation" with specific markers or points (2015b, 105). Instead of confusing this marker *for* the epoch, for C. Hamilton the Anthropocene instead represents a more holistic transformation in the overall functioning of Earth systems, rather than specific or detectable impacts on limited or specific environments, locales, or ecosystems. In this account, the Anthropocene does not begin when humans make a significant impact on the Earth's environment or ecosystems, but instead on the Earth as a totality: it must be a "a phase shift in the functioning of the Earth System. It is not a continuation of the past but a step change in the biogeological history of the Earth" (Hamilton 2015b, 100).

In contrast to Clive Hamilton, Lewis and Maslin retort that the Anthropocene is inexorably a temporal concept, in that any geological marker, by definition, requires a clear definition using the Geologic Time Scale. "Time is divided by geologists according to marked shifts in Earth's state" using the fundamental principles of stratigraphy and GSSPs (2016, 109; 2015), and hence Hamilton's claim that we are 'in' the Anthropocene is conceptually vacuous *until* this inherently stratigraphic claim is proven. "That human activity has altered Earth fundamentally is rarely questioned within scientific publications", they note, and so what is crucial now, is to formally define the Anthropocene "so this paradigm shift can be ratified as part of the Geologic Time Scale, and more easily discussed and debated within and beyond the scientific community." (2016, 111).

The point here is that, when considering temporality, the contentious debate over the Anthropocene and its golden spike is not one over *whether* humanity has "made" or impacted the Earth, but *when* this foundational and emergent moment of humanity's 'control' over planetary processes began. This is summarised well by Smith and Zeder, for example, who attempt to resolve (or circumvent) this debate by stressing the need for the golden spike as a practical, *but necessary*, measure (2013). *Their point is that a golden spike should exist*, regardless of its precision or exactness. Zalasiewicz et al. (2011) agrees, noting that "for current practical purposes—a GSSP may not be immediately necessary." Why? "At the level of resolution sought, and at this temporal distance, simply selecting a numerical age, such as the beginning of 1800 in the Christian Gregorian calendar, may be an equally effective practical measure" (2011, 1050).

Without the golden spike as its defining point and marker, there is no calendrical or chronological event from which to determine past/future, and hence no Anthropocene epoch.

The Golden Spike as the End of History: Re-Governing the Cosmos

This brings us to the central argument of this chapter. As noted above by Foucault and Arendt, the de-governmentalization of the cosmos was catalysed by the scientific discovery of deep time. This gave rise to modern statist governmentality, in which both human time and human history are indefinite. As Foucault stated, this was the time of our own "indefinite governmentality".

The concept of the Anthropocene and its golden spike inverts this cosmological narrative. As Lewis and Maslin write, once humanity is granted the power to 'make' Nature and geological epochs, this "reverses 500 years of scientific discoveries, which have continually moved humans to ever-increasing insignificance" (2015, 112). The golden spike replicates the event of Christ's birth and the temporality of BC/AD, and maintains a sense of indefiniteness, because it stretches similarly into an infinite past and infinite future. However, crucially, it also returns humanity back to the centre of its own cosmological order: humans are not passive observers of Earth anymore. "*Homo sapiens* are now central because the future of the only place where life is known to exist is being determined by the actions of humans. In fact, we would argue that humanity has become a geological superpower" (Lewis and Maslin 2016, 112). Indeed, as chapter 6 argued, the emergence of the Anthropocene may be considered as a new and global form of rationality; a counter-conduct to what came before it. If indeed this "first form of counter-conduct is the affirmation of an eschatology in which civil society will prevail over the state" (Foucault 2007, 356), then it ends history. And so we now see in the Anthropocene a counter-conduct enveloping the globe through global cycles of carbon, CO_2, and a new rationality of climatic globality.

With the golden spike designating humanity's ascension into deep time as a geological force, comes a *re-governmentalization* of the cosmos. Conceiving of humanity collectively, as "the human enterprise" (see Crist 2013), or as a species in deep time, imputes God-like status and meaning to humanity. "In Christian theological terms, the much quoted line from Genesis about humanity as having dominion over nature can

now simply be read as a statement of fact; this is the point of the Anthropocene" (Dalby 2009, 164). Just as God once governed the laws of Nature prior to the Cartesian Moment, therefore, so it is now that Earth System Science (ESS) is asserted to govern the species of humanity in the deep history of the Anthropocene. As Dalby claims, the "point is that ecology no longer allows us to formulate humanity as separate from nature. This is now simply ontologically impossible; formulations premised on such a dichotomy make no practical sense in light of earth-system science" (2009, 164). Once again, it is the human subject that is now giving form and content to the Earth, as its new maker and master.

As this thesis has thus far argued, to conflate humanity with Nature ontologically, represents a metaphysical subjectivism that actually privileges the human subject over Nature. The human subject relates itself to everything, endlessly, in what is called *relationality*. This chapter finds that the Anthropocene extends this same relationality not simply to space, but to temporality. Humanity re-governs the cosmos, but it asserts *itself* – from its past, as a golden spike, into the future as a 'we' of the collective human species – to mark a new two-point infinity of carbonic and human stratum, forever placed into the Earth. It is a new Genesis story. The human, writes Yusoff, "as an organism is made originary rather than parasitic of earth forces and is given a power of duration that far exceeds human sensibility [of deep time]" (2016, 13).

Indeed, in IR, "No one would argue that humans are the only species to transform landscapes" (Harrington 2016, 488). It becomes clear here that the human subject(ivity) can, in the Anthropocene, "in the process of dominating other species, acquire the status of a geologic force. Humans, in other words, have become a natural condition, at least today" (Chakrabarty 2009, 214). If Chakrabarty is correct, and the Anthropocene's deep time and deep history constitutes the human species as a "human collectivity, an us, pointing to a figure of the universal" (2009, 222), then what universal human arises from this "shared sense of catastrophe"? What type of humanity supposedly re-governs this cosmos engendered by a *human* spike driven into deep time? Indeed, Chakrabarty claims that "With this collapsing of multiple chronologies—of species history and

geological times into our very own lifetimes, within living memory—the human condition has changed" (2015, 180). Changed into what?

As noted in chapter 6, Heidegger cautioned that subjectivity as an 'I' is shaped "always in keeping with the way in which [a human] wills himself" (1977b, 152). In other words, a human subject can think of itself, or be an 'I', but depending on the self-interpretation of its epoch, it may also come to think or 'be' a nation, a people, a race, or a subject picturing itself "as lord of the earth." The 'I' can be cancelled out, however, by an insertion of an I, into the 'we' (1977b, 152). Indeed, even for Foucault, the "Western man is individualized" at the "price of subjectivity", or subjectiviation (2007, 231). In this re-governmentalization of the cosmos, therefore, this individualisation can be *rejected* whilst the *subjectiviation* can be increased. How? Through the positing of this new twopoint infinity – a golden spike – grounded upon the human species itself, rather than that of the liberal individual, which arose temporally during the 'indefinite governmentality' of human time. "Species may indeed by the name of a placeholder for an emergent, new universal history of humans that flashes up in the moment of danger that is climate change" (Chakrabarty 2009, 222). Yet, like deep time itself, this human 'we' as species is beyond our present comprehension. Our political rationality and its underlying metaphysics is not yet the subject of 'we', but of the Cartesian 'I'. Hence, for Chakrabarty, "we can never *understand* this universal. . . . [it] escapes our capacity to experience the world" (2009, 222). It is, as of now, incalculable. And as argued in chapters 2, 4, and 8, incalculability implies a loss of objectivity, which throws the subject back upon itself for certainty. "This becoming incalculable remains the invisible shadow that is cast around all things everywhere when man has been transformed into *subiectum* and the world into picture" (Heidegger 1977b, 135). This is inherent in the concept of the Anthropocene and its golden spike, as both are defined by the "unintended consequence of human actions and shows, only through scientific analysis, the effects of our actions as a species" (Chakrabarty 2009, 222). Across epochs, dormant within this concept, is the assumption the individual human must become the 'we'; humanity as a species, now collectively re-governing, stewarding, making, and destining Nature and the cosmos, as its relational centre.

Conclusion

This chapter has argued that the concept of the Anthropocene contains surprising ramifications for temporality, subjectivity, and human conduct. IR has presently imported and embraced the Anthropocene, yet without considering how its geologic and deep notions of temporality would render the human time of politics and IR irrelevant or obsolete if they came to fruition. Analysing and interpreting this concept through Foucault's governmentality lectures, this chapter found that the 'end of history' discussed by Foucault is in fact realised in the concept of the Anthropocene. Its GSSP marker, or golden spike, posits a new twofold infinity of a geologic past and future, in which humanity re-centers itself within the Earth and cosmos as the centre of Nature and Being. The golden spike, at its conceptual core, thus re-governs a cosmological order that was de-governmentalized by Hutton's discovery of deep time. The Anthropocene, in other words, ends history.

This re-governmentalization of the cosmos implies that humanity can only project itself into an infinite geologic future as a species, as a collective We, or as an "epochal consciousness" (Chakrabarty 2009; 2010). It fosters its own "origin/ending story" across geologic timescales (Yusoff 2016). When the cosmos was governed, Nature was, in turn, *divine*; Nature was God. "Insofar as he governs, the sovereign does nothing other than reproduce a model [that] is quite simply that of God's government on Earth" (Foucault 2007, 233). In the Anthropocene, we see that 'government' through the reproduction of a model indeed remains. However, it is now the model of the GCM and ESS operating at scales of deep time, and a golden GSSP spike that reinserts humanity at the centre of a re-governed cosmos, that orders reality. In the temporality of the Anthropocene, the human self is once again placed at the centre of past and future, now in a constant relation to all timescales. Perhaps this scenario was incidentally summarised by Bastian, when he wrote: "Our conventions for coordinating ourselves—for telling the time—are thus simply not adequate in the current context" (2012, 24). "So while the clock can tell me whether I am late for work, it cannot tell me whether it is too

late to mitigate runaway climate change" (2012, 25). For the latter, only a golden spike driven by a universal human species now forming the Earth and transcending time, will do.

Chapter 8 – Security, Entanglement, and the Paradox of the Anthropocene[1]

Introduction

The aim of this chapter is to explore how today's discourses of the Anthropocene deal with existential insecurity. Debates about the nature of 'security' have been at the core of IR since the discipline's inception. Interpreting the recent appropriation of security into the Anthropocene, therefore, grants us insight into how this concept's implicit rationality and relationality inscribes itself into explicit disciplinary practices.

Unprecedented in its spatial and temporal implications, it is no surprise that the Anthropocene is now considered as a global security problem. "Climate change may be the most obvious and pressing issue", writes Dalby (2014, 2) "but the larger picture of an Earth system in transition provides the context within which security now needs to be rethought". Yet, in order to rethink security within this transforming the Earth system, we are also told that recognising this "interconnection" with Nature overcomes "the post-Cartesian human pretense to mastery and calculation" (Burke 2010, 96). In place of securing the human being against death, therefore, security discourses now embrace the concept of 'entanglement' to secure the human subject within life or Nature. Entanglement emphasizes humanity's enmeshment with non-human forms of life and matter. This new Anthropocene security thus "requires both dissolving the image of humans as unbounded and outside nature, while simultaneously acknowledging the diverse, entangled nature of humans with the multiple subjects also threatened with future catastrophe" (Harrington 2016, 494).

This chapter argues that an epoch defined by and through the action of *anthropos*, the human, does not represent an entanglement of humanity with things, Nature, or the

[1] Sections of this chapter have previously appeared in Hamilton, S. (2017). Securing Ourselves *from* Ourselves? The Paradox of 'Entanglement' in the Anthropocene. *Crime, Law and Social Change*, pp. 1-20. (Forthcoming).

Earth. Instead, discussions of security in the Anthropocene illustrate and intensify a profound anthropocentric subjectivism: a *dis*-entanglement of humanity from Nature. The concept of the Anthropocene replaces what was once the primary and objective concern of security – i.e. survival, or avoiding death – with *anthropos*, the human being, as the new geological and spatiotemporal force to be reckoned with. With the catastrophic prognoses for the Anthropocene's future making humanity's temporal, ontological, and epistemological essence uncertain, a paradox forms: humanity must secure itself in the future *from* itself in the present, forming what this chapter calls the 'Paradox of the Anthropocene'. Upon deeper inspection, 'entanglement' is revealed as a strategy to ameliorate this existential paradox. It uses quantum sciences and physics to project a form of order; a 'certainty' of interconnection between humanity and Nature, into what is an otherwise uncertain Anthropocene future. Rather than securing its entanglement with Nature, however, the human subject grasps only its own relationality: "Thus even in science the object of research is no longer nature itself, but man's investigation of nature. Here, again, man confronts himself alone" (Heisenberg 1958, 24).

This chapter proceeds as follows. First, it provides a brief overview of how security and entanglement are commonly used and combined in IR's literatures of climatic and Anthropocene globality. Second, it examines how a specific variant of security – "ontological security", or the existential securing of a continuous sense of self[1] – best encapsulates the problematiques of security discourses surrounding the Anthropocene today. Third, by examining the concept of quantum entanglement in greater detail, it outlines how the Anthropocene and quantum science are contradictory. The chapter shows how the metaphysical subjectivism outlined throughout this thesis is what fosters this implicit conceptual dis-entanglement from Nature and the Earth. 'Entanglement', therefore, emerges from technological enframing in ways akin to the ESS and GCMs

[1] For a small but influential sample of the use of 'ontological security' in International Relations and security studies, see Huysmans, J. (1998). Security! What Do You Mean? From Concept to Thick Signifier. *European Journal of International Relations* 4(2): 226-255; Mitzen, J. (2006). Ontological Security in World Politics: State Identity and the Security Dilemma. *European Journal of International Relations* 12(3): 341-370; Steele, B.J. (2008). *Ontological Security in International Relations: Self-Identity and the IR State*. London: Routledge.

explored in chapters 3, 4, 5, 6, and 7: quantum science 'secures' only the self-certainty of a calculating human subjectivity, rather than any enmeshed or entangled Nature. Security, therefore, is just as governed by technological metaphysics and subjectivism as the digitised renderings of the global climate or the Anthropocene. Entanglement manifests relationality; the human self, drawing its own world picture, to secure itself within it.

Security in the Anthropocene

As this thesis has illustrated, the Anthropocene is portrayed as a condition of unprecedented discontinuity in Earth's geologic history. It is a human-made rupture that breeds immense uncertainty about the future of humanity and the conditions of life on the planet.

Whilst acknowledging that 'risk' is typically invoked in discourses treating "known unknowns" as uncertainties to be analytically tamed and integrated into decision making processes (Daase and Kessler 2007, 412), the uncertainty of the Anthropocene is different. With its tipping-points, non-linear feedback loops, and its reach into deep time, its uncertainty is that of a "wild card, the unpredictable that can throw over the most careful planning": an *unknown* unknown (2007, 412). With such unpredictable and intergenerational effects, the Anthropocene becomes "about securing the future," notes Dalby (2013, 185), but doing so in in different ways, and on unprecedented scales as vast as the "remaking" of the biosphere. "Insecurity is now a geological matter, not a matter of just biology or ecology in a given set of natural circumstances" (Dalby 2015, 3).

So as to reduce geologic insecurity, we are told to recognize that "we cannot survive without accepting the cosmopolitan and enmeshed nature of this world. We are an array of bodies connected and interconnected in complex ways that have little to do with nationality" (Burke et al. 2016, 502). With statist ontologies transcended, security must therefore become more interdisciplinary and holistic, recognising the consanguinity of

life and non-life as a new condition of *entanglement* (Cudworth and Hobden 2013, 654). "This entanglement does not refer simply to co-existence between humans and the natural world," stresses Harrington (2016 490), "but to a deeper type of entanglement, all the way down with other humans, beings, things, and processes. The concepts of self and other fade away." This seems ordinary or commonplace to hear in our present moment: Our Anthropocene future is uncertain and insecure, but our entanglement with it is not.

Ontological (In)Security and *anthropos*

If this new entangled Anthropocene condition is accepted, then security logics must ensure physical survival in the future by first mediating the uncertainty of planetary conditions in the present. This moves security well beyond a focus on the individual, to planetary and Earth systems that, by definition, span temporalities of deep time (see chapter 7). The key here is that this systemic and geologic transition – from the stability of our current Holocene epoch to the unpredictability of the deep time of Anthropocene – is defined by futures and Earths *uncertain*. Try as we may to model and predict the future conditions of the Earth system, no one truly knows how this security picture will actually play out (Verburg et al. 2016). In the Anthropocene, "There is no stable environment that can be protected or secured", notes Dalby (2015, 16). There are only "different pathways into what will be different futures, each with pitfalls and difficulties." Although the histories, similarities, and differences between risk and uncertainty are too expansive for this chapter to review in detail (see Daase and Kessler 2007), uncertainty is considered here as a form of non-knowledge about the future and oneself. This means its dangers are conceptualised in terms of a "lack of knowledge" about the future state of the human enterprise, so that the more we know, "non-knowledge also increases and we become more aware of what we do not know" (Daase and Kessler 2007, 419).

The difficulty with this increasing non-knowledge and uncertainty, is that it becomes reflected back upon humanity and the human subject. "The Anthropocene confronts us

with the condition in which we must redefine the very notion of the human and its freedom. There is, no more, a 'human condition' as such" (Burke et al. 2016, 521). As we erode the immutability of the stable Holocene's background context, so this familiar narrative goes, so we erode the conditions that stabilize what it means to be human. The issue becomes, therefore, how an entangled Anthropocene security may best be applied to a transforming Earth and an uncertain human condition. The certainty and security of humanity in the Holocene becomes an existential uncertainty and insecurity of *anthropos* in the Anthropocene.

If security is considered as something that defines "our relations to nature, to other human beings and to the self" (Huysmans 1998, 31), then the changing and unpredictable conditions of the Anthropocene are best captured by a concept dealing with the existential uncertainty of a discontinuous human self: *ontological security*. Having recently gained traction in IR, ontological security refers not directly to planetary, state, or physical security. Instead, it specifies how social and cultural practices secure the 'human condition' by constructing stable identities, routines, and meanings for humans.

Understood broadly, ontological security is "a subject's capacity to uphold a stable view of its environment and thereby 'go on' with everyday life" (Browning and Joenniemi 2016, 31). It is the establishment and maintenance of an existentially continuous, stable, and consistent sense of *self*, or one's being in a world. Here, the 'self' is taken as a subjectivity – an 'I' – that is certain of its own existence, or that it 'is' in being. Yet, *what* this being is – its ontology – is formed intersubjectively through norms and practices of selfhood, and its recognition. "Without ontological security," writes Zarakol (2016, 1), "the self cannot know where it begins and ends," and this is a prerequisite for *any* type of (physical) security, because "what is essential to the body (and its survival) can only be defined by the self." It is a security that makes secure and certain *what* exactly a thinking 'I' *is*. And whether thinking of multiple-selves, entangled-selves, or a single subjective 'I', there is always some 'self' doing the thinking.

Only after a self is subjectively secured as what it is – single, multiple, entangled, etc. – may objective dangers, to oneself, or one's community, group, or state – then be intersubjectively shared and established as meaningful. As Mitzen (2006) argues, even war and conflict may bring ontological security, because each can establish a clear sense of self-certainty and orderly routine to which a self can relate, and derive meaning. Ontological security is thus temporal; derivative of believing one knows what is coming in the future. Without this stable and secure self from which to engage and act in a world, security becomes amorphous.

How is this ontology of the self shaped by security? For Huysmans (1998), ontological security establishes meaning by relating the self to practices of ordering and to objects of uncertainty. These may be described in two ways. First, social order and stability secures a human self by establishing feelings of continuity; by positioning people, practices, and things within a shared social context of repetition and continuation. Secondly, since security is always a strategy aimed at giving and enhancing meaningful *life*, it always mediates and articulates a specific understanding of, and relation to, *death*. Death is the fulcrum around which all meaningful security practices gravitate, because it is the ultimate object that security practices aim to avoid. Yet, death remains an ephemeral or abstract concept (it cannot be seen, touched, tasted, etc.), and so it is dealt with by the self and human groupings by concretizing it into specific objects and referents, which are then be incorporated into routines and habits. The uncertainty surrounding death is "displaced by concretized dangers, inimical forces ranging from the devil to criminals and rival states" (Huysmans 1998, 237). 'Security' involves, therefore, not only accounting for the power of other humans to kill, but "a fear of uncertainty, of an undetermined condition. . . . The way to deal with this fear is to objectify death" (1998, 235). Explicit acts securing one's self against objective threats, evince this implicit foundational uncertainty surrounding death as the ultimate security threat.

It should strike us immediately that the Anthropocene dissolves the traditional understandings of both 'stable order' *and* 'death' that are the prerequisites for modern

forms of ontological security. What it is to be human, and the nature of mortality, are now celebrated as being transformed in this coming planetary epoch. In the Anthropocene, fundamental relationships between humanity, the Earth, and even the human self and the future of its species, are made indeterminate and uncertain. As noted in chapters 6 and 7, for example, many scholars believe that humanity can reconcile itself with this temporal uncertainty only by re-conceptualising itself as an epoch-spanning species, or as a 'We' of a collective "epochal consciousness" (Chakrabarty 2009). Within IR specifically, the authors of the recent Planet Politics manifesto proudly declare that "We must face the true terror of this moment. . . . We must be in tension with *status quo* struggles within our disciplines," so as to foster a revolutionary new global political project (Burke et al. 2016, 500, 502-503). The Anthropocene is always driven by the terror and uncertainty of non-knowledge, binding all together.

At this point it is clear that by upsetting (inter)subjective *status quos* of order, and calling for new ideas, stories, myths, and social practices, the human pursues security in the Anthropocene to ameliorate non-knowledge, or uncertainty. In doing so, the human condition and the security threats it once normalized within everyday contexts of statist geopolitics, are upended and transformed. But what replaces these outmoded agents and structures of the old international statist order? This is where notions of 'entanglement' enter IR's security discourses. "The advent of a truly entangled socio-physical nature emerges as a reason to radically challenge and rethink the possibility and desirability of unified scientific accounts of environmental change," notes Lövbrand et al. (2011, 215). Now, knowledge in the face of uncertainty can be attained by experimenting with "multiple and situated ways of seeing and acting upon the hybrid world that we now inhabit." In the "true terror" of the Anthropocene moment, therefore, human agency seems here to be rekindled in the face of uncertainty. If anything, the human self can be certain that it is entangled.

Replacing the uncertainty of an atomistic human self with this entanglement of being(s), the Anthropocene's all-embracing indeterminacy is also reduced. Entanglement instills a sense of order and stability in a future of terror and uncertainty. It does so by enmeshing

humanity with Nature itself: “we need to adapt to the world we have created . . . [while longing for] a future that allows us all to survive and honours our deep entanglement with the planet” (Burke et al. 2016, 500). Human self-certainty is now situated in a new context: the “multi-species, multi-sited entanglements within which all life is lived”, and which now “give us grounds for action” (Rose 2015, 130). Where Newtonian and modern scientific ‘knowledge’ had previously created equal amounts of ‘non-knowledge’ that increased uncertainty, therefore, entanglement is positioned to have the opposite effect: the human self, as *anthropos*, can take action because of the certitude of its entanglement. Interconnection is a certain form of support and order.

In the terror of the Anthropocene’s future, “When it is almost impossible to hierarchize threats and when the general impression is that one is in a permanent state of crisis and urgency, trust in the capacity to keep threats at a distance crumbles” (Huysmans 1998, 243). In this uncertainty, entanglement’s relational order accepts the impossibility of distancing humanity from security threats. Instead, it celebrates the proximity of all beings, reducing the self’s distance to them by stressing its holistic interconnection will all matter. Any problems or threats remaining, therefore, are framed as a problem of *anthropos*, or the human maker. Humans possess agency to secure themselves against these threats, because there is no longer any distance separating them from the entangled perils of their own making. Certainty is thus attained: “Alone with his image of the future product, *homo faber* is free to produce, and again facing alone the work of his hands, he is free to destroy” (Arendt 1998, 144).

This leads to a second crucial component of ontological (in)security in the Anthropocene: the epistemological uncertainty surrounding death and its mediation. According to Huysmans (1998, 237), the “driving force of knowledge is a fear of death as the undetermined. In that sense, death constitutes the condition of possibility of knowledge.” This future-unknown, death, congeals into objects that may then be researched and made known, thereby alleviating existential anxieties and insecurities. However, in the Anthropocene it is not death, but *the human self – anthropos* – that is substituted for death as the ultimate ‘object’ of future uncertainty, possibility, and

existential angst. In this human epoch, "what needs to be done, the future of humanity, the potential of technology and the prospects for civilization", are all indeterminate and uncertain (Dalby 2016, 2). As noted in chapters 2, 6, and 7, traditional understandings of human mortality are displaced by assertions that the Anthropocene bestows upon humanity godlike or Promethean powers to make nature and its own human condition. The golden spike replaces Genesis as a new twopoint marker of deep time, reaching into past and futures unknown. Earth system scientists thus confidently declare that it is "an undeniable reality" that "we are taking control of Nature's realm. . . . becoming the dominant force for change on Earth. . . . Remember, in this new era, nature is us" (Crutzen and Schwägerl 2011, online).

If humans *are* Nature, and the Anthropocene demands the securing of humanity (and all life) from the unpredictable planetary conditions 'we' are 'making', then the aim of security becomes that of securing oneself *from* oneself. Humanity/Nature must be secured from Nature/humanity. The object stoking ontological insecurities and demanding new and unprecedented forms of knowledge to alleviate subjective uncertainty, is *anthropos*. We know ourselves, that we do not know the future condition *of* ourselves. Security in the Anthropocene condition is, therefore, humanity entangled not with Nature, nor with the planet, but most foundationally, with itself.

This results in what this chapter calls *the Paradox of the Anthropocene*. For Huysmans (1998, 236), it was a paradox of death that generated the self's ongoing quest for ontological security. Death is an awkward "non-object" for humans, demanding the most intensive possible reasoning because it is both the ultimate truth (i.e. we all die), and the ultimate absurdity (i.e. we may externalize and think *of* death, but we can never truly *know* it because its arrival ends all cognition and reflection). Simply put, "There is a paradoxical relation between death and knowledge" because knowledge is engendered and driven to know and to secure itself against what is ultimately impossible to know and to secure itself against (Huysmans 1998, 237).

In the Paradox of the Anthropocene, the human self becomes the abstract object of knowledge that drives and defeats both reason and security in this paradoxical manner. The future *anthropos* and its world of geologic uncertainty is just as intractable to the self as death. Destabilizing our subjective and collective meanings, the Anthropocene proclaims an ultimate truth (i.e. we are all human, and we all affect nature in *some* way that has created this human epoch); and it situates this truth within an ultimate absurdity (we must all rationalize our actions in the present based upon the actions of humans in the past, so as to make due with an uncertain and unpredictable future). The profound spatiotemporal uncertainty of not knowing which dangers to confront, which to ignore, when and how to do so, and what effect our behavior today ultimately creates in the future, results in ontological insecurity (Mitzen 2006).

As noted above, this disorder and its ontological insecurity is commonly mediated in IR by stressing entanglements of "human relations and social institutions as embodied and co-constituted within systems involving a multiplicity of beings and things" and "relational systems" (Cudworth and Hobden 2013, 664). This chapter turns now to what entanglement is, and how it attempts to fill this knowledge gap opened by the Paradox of the Anthropocene.

The Question of Anthropocene Entanglement

'Entanglement' is now a popular term that refers to how humanity situates or orders itself in relation to nature, material things, and forms of matter in the Anthropocene. Rather than being ontologically distinct or existing as discrete entities, binaries and dualities of humanity and Nature collapse into a co-constituted and hybrid form. Hence the recent relevance of posthuman, trans-human, anti-human, etc., discourses in IR's studies of the Anthropocene today (see Kuehls 1996). Indeed, there are widespread multi-disciplinary uses of 'entanglement' in recent literature about the Anthropocene, ranging across theories of materialism, posthumanism, and actor-network theory (ANT) (for a succinct overview, see Hodder 2014). Rather than delve into each use and variety

of entanglement, this chapter will now focus on the science and physics most commonly bringing it into being in IR's Anthropocene discourses: quantum physics.

Generally put, quantum entanglement refers to what Einstein once disparaged as 'spooky action at a distance': the ability of particles or objects to instantaneously influence one another regardless of spatial distance, and – as some physicists now argue – regardless of time (Barad 2010). How is this conceivable, let alone possible? For Einstein, the 'principle of locality' described how the closer separate objects are to one another, the more they can influence one another in a causal sequence. Local distance and a cause thereby elicits local action and an effect. Entanglement, however, describes *nonlocality* or how separate particles can influence each other's 'spin' instantaneously, regardless of tiny or massive distances (see Bell 1964). This nonlocal entanglement is "[p]robably the most enigmatic feature of the quantum world" (Holman 2014, 149). It is a generalized form of quantum 'superposition', which is a state of complete indeterminacy (as made famous by the thought experiment of Schrodinger's cat). Here, think of an object such as an electron existing, but without any place or definite position. An electron in a superposition does not congeal into one detectable state *until* it is observed, meaning that, prior to observation, it seems as if it existed everywhere, and in all and any possible configurations. In other words, a "*quantum superposition* is a nonclassical relation among different possibilities, . . . [meaning that] being/becoming is an indeterminate matter", and thus classical notions of identity, ontology, distance, and time, are undone (Barad 2010, 251).

For Bohr, quantum entanglement pointed to how the apparatuses of measurement used in these experiments were actually what delimited and formed the concepts that made matters and forms of being/becoming thinkable and cognizable (also, see Heisenberg 1958). What quantum entanglement implies, therefore, goes far beyond the simple and classical notion of two or more states/entities/events being intertwined or enmeshed. It is "a calling into question [of] the very nature of two-ness, and ultimately of one-ness as well" (Barad 2010, 251). No particle has a fixed nature or temporality, but these are

acquired only through a complex entanglement of 'the object' and its 'agencies of observation' in the measurement process (Barad 2010).

This is hard to reconcile with IR and security studies, and for good reason: entanglement is confusing and counter-intuitive because it opposes the classical or neo-Newtonian physics upon which our everyday styles of thinking IR – our metaphysics – rest. Classical and Western (meta)physics tells us that physical objects are individual, bounded, measureable, and calculable; they exist on a linear plane of spacetime, moving from causes to effects. These may be predicted in the future, if we learn enough about their internal and external causal mechanisms and conjunctions, by measuring them. Wendt has recently noted how classical physics shapes the social sciences by determining the world in five ways: as material, separable, defined at micro- *and* macro-levels, responsive to local stimuli or causal forces, and as comprehending behavior according to internal and external forces operating causally on bodies (Wendt 2015, 151-152). So, in order to break away from this mechanistic, determinist, classical reading of reality, many scholars have now advocated post-Newtonian, complex, and non-human centered accounts of (social) reality (Cudworth and Hobden 2013).

Enter quantum physics, which offers a drastic break in IR's thinking from its classical Newtonian foundations of bounded and discrete entities. Recently, Der Derian (2013) has investigated how spooky connections of a networked global media result in spacetime oscillations between virtual and real wars, creating a type of "quantum war". For Montgomery (2016), a quantum take on security offers the potential to grasp global processes that transcend national boundaries instantaneously, such as cyberspace processes or the local-global components of drone strikes. Like quantum states, he argues, these issues and entities span the globe, "potentially even existing simultaneously in multiple spaces or even, like quantum states, acting at a distance" (2016, 104). Here, with global yet simultaneous events transcending local spatialities, security studies is attempting to scrap notions of independent, discrete, ontological units, for quantum narratives of superpositionality and entanglement.

This brings us to the combination of 'security' and 'entanglement' in discourses of the Anthropocene. Although entanglement refers to the behavior of particles at the smallest of microscopic or quantum levels, as noted above, it is used commonly as an analogy linking disparate spatialities and entities together, from micro to macro levels.[1] Declarations of our 'entangled Anthropocene condition' thus imply a quantum or paradigm-shifting transition away from classical understandings of Newtonian, localized, mechanistic, and bounded units such as bodies and states, to an understanding of politics and humanity as enmeshed with all life systems on Earth. Explicit calls to incorporate geophysical sciences such as Earth system science (ESS) and its popular planetary boundaries model (Biermann 2014; Burke et al. 2016), are indicative of this bid to re-conceptualize how security can *and will* operate: through enmeshed, complex, and simultaneous interconnections or intra-actions. This is rather different from the classical buffering of space(s) between a subject in need of protection, and the external object or threat from which it must be secured. The Anthropocene – we are told – thus renders old Newtonian security paradigms and assumptions obsolete. This raises an immediate question, which IR seems to have overlooked: can the Anthropocene and entanglement actually fit together? And if not, then why does IR now witness so much 'entanglement' discussions in Anthropocene security discourses?

Upon inspection, entanglement does not replace nor re-conceptualize our understanding of security in the Anthropocene. Ultimately, it tacitly embraces neo-Newtonian conceptual foundations that repeat classical scientific and metaphysical assumptions concerning humanity, physical security, and the manner in which a human self thinks of Nature and the Earth. In other words, the ontological insecurity prompted by the Paradox of the Anthropocene remains firmly upon Newtonian pillars, as shown through its discourses of time, science, and planetary boundaries.

First, consider *time*. The Anthropocene relies upon sciences, epistemologies, and ontologies of a neo-Newtonian and classical understanding of *geologic* time. As discussed in chapter 7 and its review of the GSSP or golden spike, the Anthropocene is

[1] For a direct application of quantum physics to social or 'macro' phenomena, see Wendt (2015).

ultimately dependent upon geologic science and stratigraphy, and their understanding of linear chronological history. Inherent in the concept of the Anthropocene is the strict temporal hierarchy of ever-finer hierarchical units or stages (dating from the earliest eon, to the more recent era, period, and finally, epoch). Basically, these divisions "represent differences in the functioning of Earth as a system and the concomitant changes in the resident life forms" (Barry and Maslin 2016, 3). The point here is not to dispute the social construction of these dating practices, nor to ignore their historicity or the fact they were initially constructed by the co-constitution of Victorian sciences and politics imbued with racist and misogynistic understandings about nature and humanity (see Dahan 2010). Rather, the point is that, ultimately, the conceptual foundation of the Anthropocene depends upon the measurement and recognition of discrete units of deep time that must be placed in a chronological and linear sequence in relation to *anthropos*, the human. If this linear Newtonian order is not followed, the concept of the Anthropocene becomes meaningless; just another point in time.

Indeed, even IR scholars embracing 'entanglement' analogies of a planetary politics must accept how the Anthropocene "revolves around a series of technical and evidential questions about how to determine the boundary of a distinct 'human' controlled geological time unit" (Barry and Maslin 2016, 9). As argued in chapter 6, the implicit conceptual foundations of the concepts structuring subjectivity thereby shape the possibilities of how we may think and act. Again, if there is no geologically and stratigraphically discrete and sedimented temporal foundation to the Anthropocene – meaning, if the Newtonian chronological sequencing bringing this concept into being is suddenly bunk – then the concept loses its significance and impact. However, this raises the question of how an entangled human/Nature Anthropocene hybrid can truly form, when its recognition and justification ultimately depends upon hierarchical and classical understandings of discrete, differential, temporal measurements, as well as the insertion, identification, and development of humanity and its impacts into this linear geologic timeframe. Rather than non- or atemporal quantum entanglement, the conceptual root of the Anthropocene looks more like thin layers of rock strata secured in deep time, and layered through a strict linear temporal hierarchy.

Second, and following from this first point, the ESS that brings the Anthropocene into being depends upon complex mathematical computer simulations combining the physics of fluid (thermo)dynamics with economic theory (see chapters 4 and 6). It is worth recalling that these "Socio-ecological models are built based on our understanding of real-world systems, grounded in physical laws for the biophysical components, and economic theory and observations for the socio-economic system components" (Verburg et al. 2016, 332). Once again, these simulations operate by quantifying Nature into grids of small and discrete variables or 'paramaterizations', which then model "direct cause-and-effect explanations through multivariate statistics of available datasets" (2016, 332). These models *project* nature outwards under the technological and representational metaphysics of enframing (see chapter 2). Here, every 'thing' in nature becomes a represented object, challenged-forth into thinkable being as a calculable coherence of forces that are amenable to quantification and simulation (Heidegger 1977a; 1977b). These ESS models also lack the capacity to parameterize and predict the inexorably *un*predictable *social* events and drivers of change, and hence, rational-choice algorithms from "economic theory and observations for the socio-economic system components" are used (Verburg et al. 2016, 332). If ESS struggles to integrate society and human behavior into its models, then layering analogies of quantum physics on top of them appears epistemologically and ontologically incongruous. 'Entanglement' thus remains in our present Anthropocene discourses as a vague analogy or buzzword invoking holism. It is an attempt at ordering the uncertainty surrounding human time and security, as projected and set forth by the inconceivable mathematical complexity of ESS models.

Although the basics of quantum physics also depends upon statistics and a type of quantum causality to make predictions, "quantum mechanics is incompatible with the view that physical observables possess pre-existing values independent of the measurement context" (Brickner 2014, 259). Nature might be manifested in certain phenomena in the macro world, but conceived through entanglement, these manifestations would be so incommensurable to everyday neo-Newtonian thought that

they would be "irreducibly beyond anything we can experience or beyond anything we can possibly conceive of" (Plotnitsky 2003, 1653). In other words, quantum uncertainty rules entanglement in a mind-boggling way, whilst the classical understandings of causality, and the certainty that we exist as human subjects that are self-certain of our own thinking 'I', still grounds our age in Newtonian and Cartesian metaphysics (Heidegger 1977b, 115). Indeed, as this thesis has thus far argued, these Cartesian and Newtonian metaphysics conducts and governs us so uniformly in and through global concepts such as climate change and the Anthropocene, that we barely even notice their metaphysical subjectivism as it becomes embraced and enacted in our everyday thought and behavior. This is relationality, and our world picture: everything becomes an insecure relation reflected back to the human self. Simply making explicit declarations that classical sciences and renderings of Nature are now 'entangled', therefore, does not actually make them so on an implicit or metaphysical level. It actually masks the self-certainty of the Cartesian subjectivity making these claims. A classical Newtonian causality still objectifies quantum entanglement itself as a thing or object, to be used and related back to a human subject and world. Or, to put this another way: IR cannot simply overcome Western metaphysics, causality, and subjectivity, simply by reading about how to overcome Western metaphysics and then declaring it to be so. This move only intensifies the technological and metaphysical conceptual foundations engendering these claims.

For example, Maslin claims the concept best framing the effect of humanity upon the Earth system is the planetary boundaries model (Barry and Maslin 2016, 2. Also, see chapter 6). These are discrete and quantitative boundaries, units, or limits, within which humanity should operate to achieve a safe space for human development. Likewise, it is this model that IR scholars are now basing their Earth System Governance (ESG) frameworks upon (Biermann 2014). Yet, these boundaries are inexorably social and subjective: they articulate "human-determined values of the control variable set at a 'safe' distance from a dangerous level (for processes without known thresholds at the continental to global scales)" (Rockström et al. 2009, 32). Ultimately, these boundaries boil down to whatever norms and ethics have been established within the group

selecting its parameters: “Determining a safe distance involves normative judgments of how societies choose to deal with risk and uncertainty” (2009, 33).

Finally, any notion of a quantified ‘safe’ space obviously retains the classical Newtonian epistemologies of calculating secure, bounded limits for the ‘future’ of humanity, that IR’s security discourses hoped entanglement would transcend. To counter the uncertainty of the Anthropocene, these boundaries prescribe a predictive orderly security. It is designed to reduce uncertainty within discrete limits or boundaries, so as to ensure the survival and development of the human enterprise from the unpredictability and uncertainty emerging outside of its limits. Indeed, humanity must respect the limits of these linear thresholds as “Earth’s ‘rules of the game’ or, as it were, . . . the ‘planetary playing field’ for the human enterprise” (Rockström, J. et al. 2009, 32). The point here is that ESS and its planetary boundaries model replicates the Western secular cosmology outlined in chapters 6 and 7. This model works by explicitly measuring the distance *between* an ‘objective’ nature and humanity, rather than focusing on enmeshment per se. Nature is once again placed into a structural numerical box as the background context from which humanity must be contrasted in order to make itself secure.

As Fagan (2016) has also noted, an implicit human/Nature dualism results from this. Any relation of the environment and security supposedly erasing the boundaries between humanity and Nature becomes itself a distinct and violent act, delineating or asserting what is or is not Nature. In this case, entanglement becomes, therefore, an analogy masking a neo-Newtonian ordering of subject to object that is actually inherent to the ESS, planetary boundaries, and thus to conceptualizing the Anthropocene. In short, if we were entangled, (1) there should be no boundaries or particulates, and (2) we could never *know* it.

Security as Dis-entanglement?

If the analogy of 'entanglement' fails to cohere with the Anthropocene, then why has it gained so much traction in IR? As this section argues, rather than interconnection, it illustrates a profound dis-entanglement that is fueled by the existential uncertainties outlined above. Entanglement and the ethical appeals now attached to it are ultimately attempts to rekindle a sense of human agency that is otherwise lost in a world of the Anthropocene's incalculability and unpredictability. Entanglement, therefore, is a quintessential example of the relationality that emerges in the globality of the Anthropocene: relating the human self to every object and referent, in an attempt to make itself more subjectively certain and secure.

Humans are undoubtedly a part of, and drastically affect, Nature. However, notions of planetary stewardship, responsibility, accountability, enfolding and intimacy, etc., are only one side of the entanglement coin. If we are truly entangled beings along quantum lines, then we cannot *choose* what to be entangled with, nor how. We simply *are*. Yet, if this is the case, we must also be equally entangled with death, destruction, catastrophe, guile, etc. And yet despite this, it is stewardship, morality, and ethical responsibility in the Anthropocene that rises to the fore of our ethical compass and discussions. Why? If *all* being/matter is entangled, then why the assumption the latter values are somehow intrinsic to us, and the former are reprehensible and should be avoided?

This capacity for ethical and moral choice and reflection about entanglement and human agency as safeguarding or intra-acting with Nature highlights humanity's *dis-entanglement*. Dis-entanglement is to recognize how the Western neo-Newtonian science and physics underpinning the ESS and the Anthropocene remains within a representationalist and technological metaphysics. It is dependent upon our own subjective certainty of our particular existence in a shared social world – as chapter 6 defined it, our 'relationality' – and the care needed to orient this sense of self, its relation to the world, and the conduct of our conduct within it. Entanglement, in-itself – *like all scientific concepts* – is amoral, indifferent, and ethically vacuous (Arendt 2006). It

simply ‘is’ as any mathematical projection ‘is’. From ESS to entanglement, therefore, “all quantification in science, appeals to our sense of objectivity, but even the most mathematically and computationally sophisticated model will not absolve us of the need for judgment, nor of the need to justify our judgments in human terms” (Oreskes 2000, 80). Calls we now see in IR for safekeeping or interconnections with Nature, are thus social and human values or aspirations, therefore, rather than any scientific fact or proof derived from quantum.

The argument here is not to evacuate the capacity for choice or ethics from the Anthropocene – again, a frightening thought – but to note how their use in security discourses concerning entanglement serves a particular function. Implicitly, this function is to make the human subject more certain of itself, in an otherwise uncertain situation, identified above as the Paradox of the Anthropocene. At first, it seems as though choosing with what, and how, one is to be entangled and interconnected, makes certain the agency of the self in an insecure epoch. But as Heisenberg (1958, 28) wrote about quantum phenomena, “Many modern creeds which claim that they are in fact not dealing with questions of faith but are based on scientific knowledge, contain inner contradictions and rest on self-deception.” Why is this certainty of a secure and entangled self based on contradiction and deception?

All knowledge of quantum entails an implicit human self-projection and representation resulting from how its measurement procedures first bring these ‘objects’ into being. We can never know ‘entanglement’ in-itself as an object or thing, but only as it is described and made objective, through mathematical measurements. In other words, “As a final consequence, the natural laws formulated mathematically in quantum theory no longer deal with the elementary particles themselves but with our knowledge of them” (Heisenberg 1958, 15). Entanglement is always, therefore, enframed, and it is grounded on a human observation and projection of itself (its own knowledge).

As Heymann (2010b, 591) has noted about GCMs and ESS, their endless quest to increase the resolution of the parameterization of their models increases their

uncertainty in turn. The higher the resolution and computational power, the more uncertainty regarding the future is produced. Order in this uncertainty and insecurity is implicitly achieved by asserting or recognising one's Anthropocene entanglement. Interconnection with Nature becomes a pillar of stability. However, it becomes clear when considering what 'quantum entanglement' actually is, that this order stems from a *self-certainty* made by relating oneself to everything in this entangled world. Security in the Anthropocene comes from the choice of how to secure oneself, from oneself generalised as the *anthropos* of the future. This is a security of relationality, therefore, because it is the dis-entangled self that chooses what to be secured from, and what it is to be entangled or enmeshed with. Again, this is the essence of relationality and its world picture: "What is decisive is that man himself expressly takes up this position as one constituted by himself, that he intentionally maintains it as that taken up by himself, and that he makes it secure as the solid footing for a possible development of humanity" (Heidegger 1977b, 132). Ironically, it is only because we are dis-entangled from Nature, that we have the subjective space or world picture to then assert ourselves *as* entangled.

This does not mean we should abandon hope for human ethics or morality, however. True, these entangled particles do not have agency; they simply are/not depending upon how they are affected by a human's measurement apparatus. Yet for Foucault, ethics remains the practice of a self's choice and freedom, but always within regimes and forms of 'truth' that are temporal and socially constructed amongst others, in shared practices (Foucault 2000e). Because we are dis-entangled, therefore, humans *do* have this socially constructed capacity for individual choice, judgment, and agency. There exists a shared human and social world of practices, traditions, cultures, and politics. And it is from this world that IR discourses construct, for an agent, the potential to choose with what to be entangled with, and how. Human subjects may retain the potential to act, even within the encroachment of a technological relationality. They may always question what implicit boundaries might hinder the explicit concepts they have taken for granted. The metaphysics grounding one's age cannot be overcome through self-assertions (Heidegger 1977b), but it *can* be critiqued by problematising the tacit or banal practices and concepts shaping everyday lives. Ironically, entanglement reduces

this human capacity for critique by asserting relational forms of order from the top-down. In seeking to gain ontological security, entanglement actually reduces agency, just as asserting oneself as 'humanity' might act as a homogenised epochal consciousness, species, or 'We' (see Chakrabarty 2009).

This gap opened by our metaphysical dis-entanglement, therefore, is not a refutation nor disparagement of Anthropocene ethics. It is a call to act ethically *through* that same historical and social space. In this sense, the Paradox of the Anthropocene might be resolved, and existential security achieved, by acknowledging this dis-entanglement of one's subjectivity from Nature and the future Anthropocene. A dis-entangled ontological security comes, at least partially, from knowing that entanglement under our current metaphysical circumstance is impossible. With this recognition comes continuity, through which we can choose to act. "Armed with ontological security, the individual will know how to act and therefore how to be herself" (Mitzen 2006, 345).

Conclusion

This chapter has argued that the Anthropocene fosters a new form of ontological insecurity: a Paradox of the Anthropocene, in which *anthropos* replaces death as the ultimate object of unpredictability and insecurity in the future. Humans are told to secure their present/future self *from* their future/present self. In response to the terror of an unpredictable and uncertain future wrought by itself as *anthropos*, many scholars now use the quantum concept of 'entanglement' to posit a new relation of *anthropos* to Nature. Entanglement implies order and certitude in otherwise uncertain times: epistemologically, to know more about humanity's enmeshment with Nature is to know more about oneself, and Nature. Ontologically, if humanity has 'become' Nature, makes it as *homo faber*, and is even mineralized into geologic strata (Yusoff 2016), then the existential uncertainty surrounding human space, time, and mortality, is reduced. Rather than increasing the distance between the human self and security threats, entanglement interconnects them, and positions the human being as their maker and master.

Entanglement thereby appears as a way to order and mediate existential uncertainty, so as to gain ontological security.

Upon analysis, however, the quantum implications of 'entanglement' are irreconcilable with the classical and neo-Newtonian foundations upon which the Anthropocene is grounded. As Heisenberg (1958) cautioned, the nature of quantum science means that humans are not measuring objective universals or referents, but only their own knowledge re-presented back to them through their own measurements. In a discipline such as IR where security is a key organising concept, the recent combination of security in the Anthropocene with 'entanglement' illustrates an attempt to alleviate this existential uncertainty by relating the calculating subject to every single referent it can cognate. Entanglement thereby forms a new type of order and certainty that reduces the anxiety experienced through Cartesian and Newtonian metaphysics, and the Paradox of the Anthropocene. However, in relating the human subject to everything – including its own security threats, in a future determined by itself as *anthropos* – entanglement is the pinnacle of what this thesis has identified as relationality. It secures a globality dependent upon technological subjectivism. Yet, it is the ability to choose or act within this uncertain Paradox of the Anthropocene, that a human subject's dis-entanglement from Nature is highlighted. It is only by accepting one's own subjective distance or separation from Nature and the Earth, therefore, that the capacity to act ethically as a human agent embedded within relationality, may be channeled into the capacity for critique. Dis-entanglement may thereby foster ontological security by recognising a continuous self, possessing at least this small certainty within an otherwise uncertain Anthropocene epoch.

Chapter 9 – Conclusion: Humanity at the Edge of its Epoch

> Probably never in human history [has] a single and universal understanding of climate existed.
> (Heymann 2010b, 593)

> The fundamental event of the modern age is the conquest of the world as picture. The word 'picture' now means the structured image that is the creature of man's producing which represents and sets before.
> (Heidegger 1977b, 134)

This chapter begins with a brief summary of the findings of this thesis. It then discusses the limitations of this project, emphasising what its research does and does not do. It concludes by outlining the implications of this research for International Relations (IR) as a discipline more generally, elaborating why the findings of this project are meaningful and important.

This thesis project offered a novel interpretation of globality and (global) governmentality in IR. Its research has answered the question of how we in IR have come to 'think' of global climate change and the Anthropocene the way we do today. It has argued that a global governmentality shapes our thought and conduct whenever we think about the 'global' climate or the Anthropocene epoch. These concepts function as political technologies that render reality thinkable in specific ways. Through its genealogical tracing of these concepts and how they intersected with the nation-state and the discipline of IR, it illustrated how they emerged into being through a complex intersection of natural, scientific, and nuclear physics, sciences, practices, and discourses. It has also combined governmentality analytics and technological metaphysics to show how these concepts shape subjectivity when they are learned and used. Rather than create a global polity in accordance with traditional notions of spatiality or sovereignty, therefore, it has illustrated how this new form of global governmentality is ultimately (inter)subjective, and grounded upon scientific processes: its shared concepts of globality intensify an anthropocentric subjectivism, identified here as 'relationality'. With every thought of the global climate or the Anthropocene epoch, the human subject is ultimately calculating, measuring, and seeing, itself. This is what

Heidegger described as the subjectivism of the world picture: "Man as representing subject, however, 'fantasizes,' i.e. he moves in *imaginatio*, in that his representing imagines, pictures forth, whatever is, as the objective, into the world as picture" (1977b 147). Yet this world picture implies a potential shift of the *subiectum*: from the I of Cartesian metaphysics, to a self-certainty now established through the 'We' of a globalised notion of humanity as a species, reaching across unprecedented spatial and temporal boundaries.

Despite being components of a greater whole, each chapter in this thesis project is also able to stand on its own, offering a novel and unique argument and contribution concerning how a piece of this puzzle of climatic and Anthropocene globality, came into being.

Although situated in IR, readers may have noticed literatures incorporated here from other disciplines, such as the history of science (Edwards 2010), geography (Hulme 2010), and Earth systems science (Crutzen 2002; Zalasiewicz et al. 2011). Some may (at first) consider this a limitation of this thesis, since its author is neither a climate scientist nor a geographer. However, a multi-disciplinary scope not only points towards potential and fruitful cross-disciplinary conversations in the future, but it highlights a crucial contribution of this thesis project. It is the first critical and genealogical analysis in IR concerning (1) How the global climate relates to the Anthropocene epoch specifically, and (2) How the scientific concepts underpinning governmentality, climate change, and the Anthropocene, shape the subjectivities, rationalities, and hence disciplinary debates, emanating from them. It has also been able to outline for IR a methodology for (global) genealogy and governmentality, that it hopes scholars will adopt going forth. Readers may have also noticed that the thesis does not delve heavily into authors steeped in science and technology studies (STS), new materialism, post-humanism, or Actor-Network Theory (ANT). Although these literatures excel in analysing the relationships between science, society, and politics, they are each massive in their scope and breadth, and thus have largely been omitted due to (1) the space constraints of this thesis, and (2) the aim to elaborate more specifically on the combination of Foucauldian, Arendtian,

and Heideggarian philosophies. However, it is hoped that incorporating these literatures to both aid and to critique the claims made in this thesis, will be embraced by IR scholars in the future.

Following from this latter point, it must also be mentioned that the position of this thesis is one that interrogates the historical and social construction of human thought across time. As such, it is at odds with critical IR scholarship that conceives of climatic globality and the Anthropocene as a relational ontology, indicative of a new 'entangled' human condition that upsets or overcomes binaries of subject/object or human/nature by reconceptualising matter and materiality. Contrary to these claims, this thesis has traced how the historical and social conditions underpinning present thought and discourse in IR emerged through a complex combination of scientific rationalities, technologies, and political interventions into environmental and global governance. It thus agrees with Arendt (1998, 183) that "The basic error of all materialism in politics . . . is to overlook the inevitability with which men disclose themselves as subjects, as distinct and unique persons, even when they wholly concentrate upon reaching an altogether worldly, material object." The concept of 'relationality' developed by this thesis, and which it argues underpins our present global governmentality evinced through climatic globalities, is indeed intangible in this very sense – a relationship of power and knowledge communicated between thinking human beings in plurality – yet this makes it no less real, nor less important to consider when investigating why and how climate change and the Anthropocene 'matters' to us now, and in the future, as we endlessly relate ourselves to it as the 'We' of a human species now affecting the globe itself.

Findings: Globality as the mask of subjectivism

As Foucault (2007, 276) stated pithily in his 1977-1978 Collège de France lectures, his intention was never to provide "a genealogy of the state itself or the history of the state." Rather, his intention was to interpret the practices and rationalities that combined, at a specific point in time, to make the state seem real; to bring the state into being as a tangible, thinkable, debatable, collection of shared and reflected practices. In elaborating

upon this aim, Foucault made an analogy that animates the spirit of this thesis: "My aim has not been to give you the history of the planet Earth in terms of astrophysics," he quipped (2007, 276), "but to give you the history of the reflexive prism that, at a certain moment, allowed one to think that the Earth was a planet." In other words, the goal of Foucault's genealogy was not to provide a concrete or universal history that would stand for all posterity. Rather, the point of every genealogy is to interpret how, through a unique combination of social practices and ways of thinking, an object taken for granted – such as the Earth as a planet, or the globality of the climate – becomes an immutable or natural concept. The point is to make us question our present moment anew, whilst accepting with humility that this present will also inevitably change. This is what makes a genealogy ongoing, as a "critical ontology of ourselves [that] must be considered not, certainly, as a theory, doctrine, nor even as a permanent body of knowledge that is accumulating", but an ongoing ethos of self-critique; "the historical analysis of the limits imposed on us and an experiment with the possibility of going beyond them" (Foucault 2000, 319).

With this impetus in mind, this thesis identified and proceeded through four essential stages of a genealogical analytic: problematisation, practice, rationality, emergence. After demonstrating that Foucauldian genealogy can be used concurrently with Heidegger's metaphysics and Arendt's analyses of the social, it moved on to trace how these concepts of climatic globality emerged in IR. It found the underlying *problematique* to be a catastrophic global climate change wrought by nuclear winter and calls for world order; its *practice* to be the complex computer simulations of GCMs, embracing a physics of fluid dynamics too complex for human calculation and cognition; its *rationality* to be one of powerlessness and failure, in which humanity is constructed as helpless to repair a concept of climatic globality always already damaged and broken; and finally, the *emergence* of a new political rationality in the early 2000s: a global biopolitics of carbon, rendered intelligible by computerised simulation models of the ESS, and ranging from atomic to global scales. From this genealogical event, this thesis was therefore able to analyse how these de-naturalised concepts structure forms of

temporality, security, and (quantum) entanglement that IR takes for granted across its literature today.

If "modes of thinking themselves are made possible and structured through *concepts*" (Crist 2013, 139), then the scientific and mathematical foundations of the concepts of climate change and the Anthropocene structure a specific mode of thinking. Indeed, this thesis has illustrated this mode of thinking to be a form of global governmentality based upon scientific renderings of Nature. It is a mode of thought and conduct made thinkable only through simulations framing the atom of carbon and the human self in a specific way: as a quantified and incalculable relation of forces (Heidegger 1977a). This form of enframed governmentality has two effects directly relevant to IR. First, global climate change and the Anthropocene are de-politicised due to the technological and metaphysical constitution of their concepts as enframed, or thinkable only through this calculative 'world picture'. As argued in chapter 4, the unpredictability required for inventive political action is curtailed, through a politics grounded upon natural science and physics. Once politics is oriented by a physics through which "nature reports itself in some way or other that is identifiable through calculation and that it remains orderable as a system of information" (Heidegger 1977a, 23), action is restricted to the boundaries of possibility *within* this same system of information. Hence, this conceptual restriction becoming standardised within the shared GCM models that frame climatic globalities we take for granted. This results in endemic failures of climate governance, as noted in chapter 1 as it situated the context of climatic globality in the COP21 climate conference. This projects thus contributes to literatures on climate governance and planetary boundaries by stressing the implicit conceptual limitations that these scientific practices may place on policymaking. Prior to seeking solutions, policymakers must first ask how their problems have been made thinkable as a tangible political rationality.

Second, another contribution of this thesis lies not in what this global governmentality does, but how it is made thinkable: through a technological and metaphysical subjectivism, that reconceives Nature *as* humanity. This subjectivism was outlined in chapter 2 and traced to its emergence in chapter 6. Chapters 7 and 8 highlighted

examples of how this subjectivism shapes contemporary thought in IR, by relating temporality, security, and entanglement, always implicitly back to the securing of the human self. Indeed, it was found that the way the human subject relates everything back to itself was accomplished through the common medium or substrate of *carbon*. The carbon atom is irreducibly present across space and time in discourses of climate change and the Anthropocene alike. Yet, whilst some IR literatures do examine the effect of carbon upon individual conduct and action (Rothe 2011; Paterson and Stripple 2010; Stripple and Bulkeley 2014), carbon and climate are not problematised, but treated as stable or universal concepts. These studies simply apply the carbon atom to the familiar liberal and statist narratives of governmentality cautioned in chapter 2. Yet, just as the application of physics to the entity of 'population' once allowed the processes of a society to be discovered and hence governed (Foucault 2007; Barry et al. 1996), so today does the application of the physics of ESS to the entity and territory of the 'globe', bring this new form of global governmentality into being. Through the carbon atom, it is a governmentality in which human subjectivity is endlessly related to the Earth and governed through mediums such as CO_2. As the complexity and sheer incalculability of the scale and processes of these global flows are outlined, human certainty becomes grounded in the self as its foundation. What emerges from this carbonic subjectivism is what this thesis has identified as *relationality*: a form of subjective conduct in which the only possible way to cognate and think about the world, is to relate it to oneself as an external object one has made, and hence controls.

Limits: What this thesis does and does not do

This section reflects on some potential limitations of this thesis, and how these are mediated or overcome by its methodology and conclusions. It also discusses new avenues of research in the future that it is hoped IR will engage.

First, let us recall Foucault's concerns over what he called the intellectual "blackmail" of either "being for or against the Enlightenment" (Foucault 2000a, 314). Here, Foucault was adamant that the ethos of genealogical methodology, the ongoing critique of

ourselves as a "limit attitude", should not be misconstrued as a statement *for* or *against* whatever referent was being problematised. For instance, Foucault was neither for nor against the Enlightenment (nor the state!) per se, but his genealogical critique asked *how* these concepts emerged into historical being, so that the limitations these concepts created within thought could be reconsidered anew. This being said, it is no secret that Foucault remains 'blackmailed' to this day, still being accused of assaulting "Western civilization" itself through an immoral or truth-less nihilism (Hartman 2015, 3).

In a like fashion, this thesis hopes to avoid being charged with an analogous 'blackmail' of the global climate or the Anthropocene. Indeed, a danger of this project might be that it is misconstrued as being 'for or against' these concepts. Hence, it should be repeated here that its point is to consider *how* the sciences rendering these concepts thinkable, shape and delimit the possibilities and limitations for thought and action enacted through them. Just as Foucault's goal was to examine "the reflexive event, the set of processes" by which the concept of the Earth as a planet, or the state as a governing authority, entered into thought and action (2007, 276), so this thesis explored how the global climate and the Anthropocene have emerged into being and were made thinkable and debatable in IR. It does not reject the dire prognostications of climate science or ESS, but critiques how many concepts and practices emerging from them have become taken for granted without considering the boundaries and limits they place upon thought.

Second, this thesis does not attempt to make ethical prescriptions or recommendations concerning what to *do* about global climate change and the Anthropocene. Although it is indeed sympathetic to the goals of many of the pieces of scholarship it critiques (e.g. Burke et al. 2016; Burke 2010; Mitchell 2014), the purpose of a genealogy is different. It asks how these claims are made thinkable, but it does not judge their moral or ethical worth. Indeed, this limitation ties in to what Bartelson (1995, 77) isolated as the "standard" list of objections to genealogy and Foucauldian scholarship. These include: an arbitrary outlook on history; a blurring of present and past; the denial of a universal or suprahistorical point of view; a study of fluid rather than fixed identities; and a sampling of cases and examples that "is never representative and does not cover the

wealth of sources." Note, however, that each of these (supposed) limitations depends on maintaining a sense of the presentism/finalism identified in chapter 2. As Bartelson notes (1997, 77), if one accepts that the constitution of subjectivity changes over time, yet the point is to analyse the *present* and not the past, then: "it must therefore recognize that its own vantage point, its own perspective, is the outcome of the history reconstructed on the basis of it", becoming elliptical in its form and narrative in its structure. In other words, one cannot claim to denaturalise immutable truths or concepts through nominalism, whilst also attaching them to universal or permanent moral structures that prescribe action.

Despite this, the value of this thesis to scholars perhaps not persuaded by a genealogical methodology or governmentality analytic, still remains strong. For instance, aside from its findings concerning global governmentality, it has generated new insights into the nuclear foundations of the concept of the global climate and the tracing of carbon and CO_2, that may be incorporated into future IR studies that choose to bracket Heideggarian metaphysics, Foucauldian governmentality, or the concept of relationality. Likewise, the implications of this carbonic relationality for IR today, as evinced in chapters 7 and 8 – i.e. that geologic time is irreconcilable with human time and history, or that 'entanglement' discourses are irreconcilable with the Anthropocene itself – may still be adopted for consideration or debate in discourses of time, security, quantum physics, etc. Although this genealogical tracing has demonstrated the implicit technological subjectivism underlying the concepts of the global climate and the Anthropocene, IR scholars eschewing genealogy or governmentality may still respond to the unique and specific contributions generated in each chapter.

Finally, a limitation of this thesis might be, what appears at first glance, to be a collection of disparate or unrelated subject matters. Each chapter engages a slightly different combination of philosophers, and substantive content – from Foucauldian genealogy and governmentality, to Heideggerian metaphysics, to Arendtian analyses of the human condition. It also engages a wide range of applications and practices, from world order and nuclear winter in *Bulletin*, to quantum science in paradoxes of

Anthropocene security. Yet – like taking steps back from a mosaic, or listening to the complete album of a musician such as David Bowie or Radiohead – when considered as a whole, this thesis presents a unified account of how its problematised referents came into being, and how in each case examined here, they subjectify humanity through incomprehensibly complex sciences and physics. To quote Arendt, each chapter touches upon how the scientific concepts we have taken for granted

> brought about the world we live in and resulted in the Atomic Revolution, [and] has led into a situation in the sciences themselves in which man has lost the very objectivity of the natural world, so that man in his hunt for 'objective reality' suddenly discovered that he always 'confronts himself alone'." (Arendt 2006, 271).

Each chapter of this thesis is thus a piece of a puzzle that forms the same overarching picture: a globality that is not of Nature, but has crystalised recently through a reflexive prism of technology, carbon, and subjectivity. This is a global governmentality in which we all partake, whenever we 'think' of climate change or the Anthropocene. It is a manner in which we are governed, and govern ourselves.

With some of its limitations outlined, it is important to highlight how this thesis project can contribute to IR's literature going forth. In chapter 1, this thesis stated that its aim was to diagnose what it is that rationalities of climate change and the Anthropocene 'do'. Once again, to quote Foucault: "People know what they do; they frequently know why they do what they do; but what they don't know is what what they do does" (quoted in Dreyfus and Rabinow 1983, 187). With the subjectivist relationality of these concepts having been outlined through this genealogical project, the next question becomes: knowing what these concepts 'do', what can the findings of this thesis now do for IR in the future?

First, this thesis not only enhances the potential to discover new and/or global forms of governmentality, but it also helps to answer the disciplinary question of whether IR's recent dearth of "grand theoretical debate" signals the "End of IR Theory" (Dunne et al.

2013, 407). In this recent debate, IR scholars considered whether the discipline's theoretical and philosophical wellsprings had run dry, and hence, whether grand theories encompassing global politics would yield to middle-range forms of analytical eclecticism. The findings of this thesis suggest not. From its application of governmentality and genealogy to new global referents, to Arendt's basic point that 'natality' or the capacity to begin something anew (and hence, something active and unpredictable) is part of the human condition (1998), this thesis demonstrates that concepts as familiar as the 'global' and the 'subjective' still contain hidden potential for new IR theories and concepts to emerge.

Indeed, the capacity for IR theory to engage with grand theory and political philosophy may indeed be refreshed if naturalised and/or scientific referents stop being taken for granted, and are problematised accordingly. This project offers only one potential methodology and example for doing so, but it indicates that countless other projects could follow. Agreeing with Foucault and Arendt, therefore, it shows how even 'commonsensical' concepts such as the globality of the climate, may generate new political insights if enough thought is dedicated to them with humility and creativity. "Each book transforms what I was thinking", Foucault once said (2002e, 240). The goal of research is to transform the point of view from which we began, "and in order to not think the same thing as before." The close reading of Foucault's 1977-1978 lecture series conducted throughout this project supports this: it revealed notions of atomic biopower and global biopolitics (see chapter 6), and a form of governmentality ushering in the end of history (see chapter 7), that IR had previously ignored or overlooked. With a different genealogical lens, therefore, there is no reason to assume that other concepts and philosophies are not still waiting to be uncovered, within the work of Foucault or any other philosopher or thinker.

Second, this thesis has outlined the potential for governmentality analytics to move in global directions by combining it with genealogy. This highlights the potential for a new form of global genealogy to be developed in the future. As outlined in chapter 2, the form of global governmentality evinced in this thesis underpins and precedes liberal and

statist governmentalities by grounding itself on how scientific processes are applied to political territories and concepts. What this methodology implies is that a genealogical inquiry and governmentality analytic may perfectly well be suited to other global *and* scientific concepts that are also used and naturalised in IR in similar ways. For instance, although Hom (2010) has recently claimed to "offer a genealogical account of modern time as a global convention", his analysis – although erudite and fascinating from an historical perspective – does not actually engage in any specific Foucauldian genealogical, nor governmentality, methodologies nor analytics. It is grounded on secondhand sources alone (especially Toulmin 1990). Hence, combining a genealogical and governmentality analytic on Western time as a scientific global practice and process – through a *global genealogy* – opens the possibility for a new understanding of its history and contemporary conceptual limits. Indeed, a wide range of scientific and global concepts such as time, water, electricity, hospitals, cancer, etc., offers rich and untapped potential for an expansive variety of new rationalities and governmentalities that are global in scope, to emerge. It is hoped this thesis and its methodology can serve a toolbox for scholars to use, borrow from, and to critique and adjust accordingly, going forth into new considerations of global politics.

Third, this thesis has argued that IR scholars must exercise greater caution when importing concepts from the natural, physical, nuclear, and quantum sciences. Each chapter has detailed how these scientific concepts contain implicit limits, boundaries, and possibilities that affect the discourses and forms of politics enacted from them when they are used. Indeed, perhaps this reflects a form of conceptual "amnesia" that the discipline of IR – and even its critical scholars – is recently succumbing to (see Neumann 2014). Here, although IR treats history as "something to think *about*, there is also the question of what we need to think *with*" (2014, 336). What this research project offers IR, therefore, is thus a firm reminder that history and philosophy are not bunk, but they are what IR must think *with* so as to go *forth* into a future of global concepts, crises, and politics. Like the models and simulations of atmospheric science or the movements of carbonic particles, no concept is neutral or objective, as is clearly demonstrated through the technologies of ESS and their treatment of humanity as a rational-choice

algorithm (Verburg et al. 2010) and of Earth systems as numerical grids and boxes (Dahan 2010). Problematizing the implicit foundation of the scientific concepts it uses, is therefore essential. In so doing, IR may include within its analyses how to think 'with' these concepts. Tracing when, how, and through what practices they entered IR, should help scholars in the future determine what they can and cannot do when concepts and practices of the sciences are applied to the sovereign and suzerain relations of states, or the geologic movements of the human species across time.

The World Picture Drawn in the Sand

Whether it is "globality" phrased in terms of globe, planet, or world(s), "we all inhabit and experience Earth not only as a meaning-bearing assemblage and physico-ecological support but also the very substrate of our species' inbuilt experiences of struggle, pain, beauty, love and death" (Edwards 2016, 193). Globality is therefore deemed ubiquitous and commonsensical across IR, and the social sciences. Humanity must now "live in the age of the managed planet", and climate change and the Anthropocene are thus human-made threats to be solved, in futures perhaps not so distant. This is, as IR scholars now readily declare it, our inevitable future, our Earthly crises, our failed COP21, and the Earthrise of a shared planetary "world-picture" at which we all must now stare (Burke et al. 2016; Peoples 2016; van Munster and Sylvest 2016).

What this thesis implies going forth is that the greater the scale, complexity, and catastrophic potential of globality, the more it is buttressed and framed by an anthropocentric subjectivism. The more humanity claims to make nature, the more it evinces and channels itself into the same processes it laments. The Anthropocene epoch in which we must now transform IR – and our climate, ourselves, our human condition – is now elevated to an IR "at the end of the world" (Harrington 2016, 489). Yet this human world has indeed seen such ends before. As Foucault himself wrote at the conclusion of *The Order of Things*,

> And yet the impression of fulfilment and of end, the muffled feeling that carries and animates our thought, and perhaps lulls it to sleep with the facility of its promises, and makes us believe that something new is about to begin, something we glimpse only as a thin line of light low on the horizon – . . . prove no doubt that man is in the process of disappearing.
>
> (1973, 384, 385)

Like Foucault, the Anthropocene similarly claims that "man is an invention of recent date", and humanity's transformation into Nature and the Earth's systems will erase our modern human condition "like a face drawn into the sand at the edge of the sea" (Foucault 1973, 387, 385). Or, in the case of *anthropos*, bombed into a single layer of rock stratum, lost in a geologic infinity of deep time.

However, from the carbon atom, to global atmospheric processes, to thinking of humanity as a geologic species and geophysical power, it seems that humanity remains resilient. It appears consigned to project, measure, and calculate itself *as* Nature; to recognise planetary imaginaries and globalities, by relating them always, and implicitly, to its own position as subject. Today's 'end of the world' is a position from which certainty is now derived, and intensified, because our understandings and concepts of globality are far beyond human conception and cognition once their mathematical constitution is actually considered. "This becoming incalculable remains the invisible shadow that is cast around all things everywhere when man has been transformed into *subiectum* and the world into picture" (Heidegger 1977b, 135). Hence the relevance of the world picture to climatic globality today: it is the self, deriving certainty from its own subjectivity, projecting itself as the maker and measure of all things, because behind the curtain of its concept of Nature is a world now too mathematically complex to objectively grasp.

In the concepts of climate change and the Anthropocene, humanity is framed as a species that not only draws its face in sand at the edge of a sea, but engraves itself within rocks bounding new epochs. Etched is the world picture of a carbon atom. Perhaps, as Foucault claims, humanity may indeed disappear into the waves of human

time, or the epochs and eons of deep time. But here – fossilized, mineralized, making itself into the Earth – humanity seems always to return, just to see itself staring back. Without recognising that this world picture is a self-portrait, humanity risks consigning itself to repeat this sketch, onwards into the cosmos, and inwards into itself,
ad infinitum.

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